

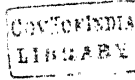
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SELECTIONS

FROM

THE RECORDS

OF THE



GOVERNMENT OF INDIA,

(HOME DEPARTMENT.)

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N°. XIV.

Minute

BY THE

MOST NOBLE THE GOVERNOR GENERAL OF INDIA;

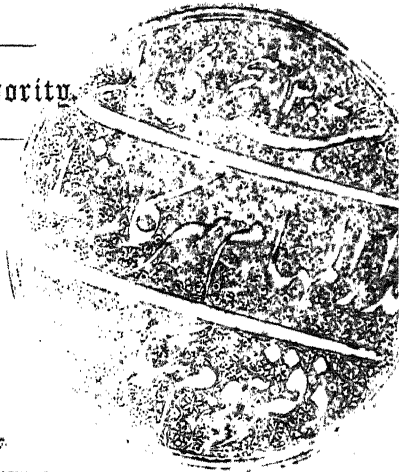
DATED THE 28TH OF FEBRUARY 1856.

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Calcutta:

THOS. JONES, "CALCUTTA GAZETTE" OFFICE.

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1856.



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# Minute

BY THE

MOST NOBLE THE GOVERNOR GENERAL OF INDIA ;

*Dated 28th February 1856.*

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1. THE time has nearly come when my administration of the Government of India, prolonged through more than eight years, will reach its final close. It would seem that some few hours may be profitably devoted to a short review of those eventful years, not for the purpose of justifying disputed measures, or of setting forth a retrospective defence of the policy which may, on every several occasion, have been adopted, but for the purpose of recalling the political events that have occurred, the measures that have been taken, and the progress that has been made, during the course of the administration which is about to close. I enter on that review with the single hope that the Hon'ble Court of Directors may derive from the retrospect some degree of satisfaction with the past, and a still larger measure of encouragement for the future.

2. When I sailed from England in the winter of 1847 to assume the Government of India, there prevailed universal conviction among public men at home that permanent peace had at length been secured in the East. Before the summer came we were already involved in the second Sikh War.

That we were so, was due to no precipitation or fault of ours. The murder of the British Officers at Mooltan, and the open rebellion of the Dewan Moolraj, were not made pretext for quarrel with the Government of Lahore. On the contrary, the offence of the Dewan Moolraj was sedulously distinguished from national wrong. The Sikhs themselves were called upon to punish Moolraj as a rebel against their own Sovereign, and to exact reparation for the British Government, whose protection they had previously invoked.



But when it was seen that the spirit of the whole Sikh people was inflamed by the bitterest animosity against us—when Chief after Chief deserted our cause, until nearly their whole Army, led by Sirdars who had signed the treaties, and by Members of the Council of Regency itself, was openly arrayed against us—when, above all, it was seen that the Sikhs, in their eagerness for our destruction, had even combined in unnatural alliance with Dost Mahomed Khan and his Mahomedan tribes—it became manifest that there was no alternative left. The question for us was no longer one of policy or of expediency, but one of national safety.

Accordingly, the Government put forth its power. After a prolonged campaign, and a struggle severe and anxious, the Sikhs were utterly defeated and subdued, the Affghans were driven with ignominy through the mountains, and the Punjab became a British Province.

3. When little more than two years had passed, the Government of India again was suddenly engaged in hostilities with Burmah.

Certain British traders in the Port of Rangoon had been subjected to gross outrage by the Officers of the King of Ava, in direct violation of the Treaty of Yandaboo.

Holding to the wisdom of Lord Wellesley's maxim, that an insult offered to the British Flag at the mouth of the Ganges should be resented as promptly and as fully as an insult offered at the mouth of the Thames, I should under any circumstances have regarded it as sound policy to exact reparation for wrong done to British subjects from any Native State. But our relations with the Burmese Court, and the policy it had long pursued towards us, imposed upon the Government of India, at the time to which I refer, the absolute necessity of exacting from it reparation for the systematic violation of treaty of which British traders had now made formal complaint.

Of all the Eastern nations with which the Government of India has had to do, the Burmese were the most arrogant and overbearing.

During the years since the treaty with them had been concluded, they had treated it with disregard, and had been allowed to disregard it with impunity. They had been permitted to worry away our Envoys by petty annoyances from their Court, and their insolence had even been tolerated when at last they vexed our commercial Agent at Rangoon into silent departure from their port. Inflated by such indirect concessions as these, the Burmans had assumed again the tone they used before the War of 1825. On more than one occasion they had threatened

re-commencement of hostilities against us, and always at the most untoward time.

However contemptible the Burman race may seem to critics in Europe, they have ever been regarded in the East as formidable in the extreme. Only five-and-twenty years before, the news of their march towards Chittagong had raised a panic in the bazars of Calcutta itself; and even in the late War, a rumour of their supposed approach spread consternation in the British Districts of Assam and Arracan.

If deliberate and gross wrong should be tamely borne from such a people as this, without vindication of our rights or exaction of reparation for the wrong, whether the motive of our inaction were desire of peace or contempt for the Burman power, it was felt that the policy would be full of danger; for the Government of India could never, consistently with its own safety, permit itself to stand for a single day in an attitude of inferiority towards a Native power, and least of all towards the Court of Ava.

Every effort was made to obtain reparation by friendly means. The reparation required was no more than compensation for the actual loss incurred. But every effort was vain. Our demands were evaded; our Officers were insulted. The warnings which we gave were treated with disregard, and the period of grace which we allowed was employed by the Burmese in strengthening their fortifications, and in making every preparation for resistance.

Thereupon the Government of India despatched a powerful expedition to Pegu, and within a few weeks the whole of the Coast of Burmah, with all its defences, was in our possession.

Even then the Government of India abstained from further operations for several months, in the hope that, profiting by experience, the King of Ava would yet accede to our just demands.

But our forbearance was fruitless. Accordingly, in the end of 1852, the British Troops took possession of the Kingdom of Pegu, and the Territory was retained, in order that the Government of India might hold from the Burman State both adequate compensation for past injury and the best security against future danger.

4. Since hostilities with Burmah ceased, the Indian Empire has been at peace.

No prudent man, who has any knowledge of Eastern affairs, would ever venture to predict the maintenance of continued peace within our

Eastern possessions. Experience—frequent, hard and recent experience—has taught us, that War from without or rebellion from within may at any time be raised against us, in quarters where they were the least to be expected, and by the most feeble and unlikely instruments. No man, therefore, can ever prudently hold forth assurance of continued peace in India.

But having regard to the relation in which the Government of India stands towards each of the several Foreign powers around it, I think it may be safely said that there seems to be no quarter from which formidable War can reasonably be apprehended at present.

5. Although the mission which lately proceeded to the Court of Ava, with the primary object of reciprocating the friendly feeling which the King of Ava had previously shown by voluntarily despatching an Embassy to the Governor General of India, has brought back with it no treaty of alliance or of commerce, I nevertheless regard the continuance of peace between the States as being not less secure than the most formal instrument could have made it. When the Hon'ble Court recalls to mind that from the very first, in 1852, I deprecated the reconstruction of any Treaty relations with the Court of Ava at all, it will not be surprised to find me add, that I still consider peace with Ava as even more likely to be maintained in the absence of all commercial or friendly treaties, than if those conventions had been renewed as before.

It is admitted on all sides that the desire of the King of Ava for lasting peace is genuine and sincere. It is admitted that his will is supreme, and his authority without dispute, among his Chiefs and people. A sense of inferiority has penetrated at last to the convictions of the nation. The Burman Court and the Burman people alike have shown that they now dread our power; and in that dread is the only real security we can ever have, or ever could have had, for stable peace with the Burman State.

6. For nearly forty years Nepal has faithfully observed the peace she bought so dearly. Her minister, sagacious and able, has himself been witness of the vast resources of our power, during his recent visit to Europe. He has been for some time engaged in a War with Thibet, which has been productive of heavy charge, while it has brought neither power nor profit to Nepal, and must have given umbrage to China, whose tributary she is. From Nepal, therefore, there is even less probability of hostility now, than in any one of the forty years during

which she has in good faith observed the peace, which she solemnly bound herself to maintain, and which her obvious interests recommend.

7. Maharaja Golab Sing of Jummoo and Cashmere, so long as he lives, will never depart from the submissive policy he announced, with unmistakeable sincerity in his air, when in Durbar at Wuzeerabad he caught my dress in his hands, and cried aloud,—“ Thus I grasp the skirts of the British Government, and I will never let go my hold !”

And when, as must soon be, the Maharaja shall pass away, his son, Meean Runbeer Sing, will have enough to do to maintain his ground against rivals of his own blood, without giving any cause of offence to a powerful neighbour, which he well knows can crush him at its will.

8. On the Western border a Treaty has been made with the Khan of Kelat, whereby he becomes the friend of our friends and the enemy of our enemies, and engages to give us temporary possession of such positions within his Territory as we may at any time require for purposes of defence.

9. Lastly, a Treaty was concluded, during the past year, with the Ameer Dost Mahomed Khan of Cabool. It bound him to be the friend of our friends and the enemy of our enemies, while it imposed no corresponding obligation upon us from which inconvenience or embarrassment could arise. The Ameer himself sought our friendship, and he has already shown that he regards it as a tower of strength.

Thus the enmity which existed through many years, and which was aggravated by the Affghan policy of 1849, has happily been removed without any sacrifice on our part and to our manifest advantage. An alliance has been timely formed with the leading Affghan State upon the solid basis of common interest against a common enemy. Already the consequences of the treaty have developed themselves in the conquest of Candahar by the Ameer Dost Mahomed Khan, an event which has largely increased the Ameer's power, while it has brought to pass for us, that every portion of our Western Frontier, from the Himalayas even to the Sea, is now covered against hostile attack by the barrier of a treaty with a friendly power.

I venture to think that the Court of Directors will see in this brief summary ample reason to be content with the condition in which I leave the relations of the Hon'ble East India Company with every Foreign State around its border.

10. As regards the internal tranquillity of the Empire, I have already observed that no man can presume to warrant its continuance, with

certainty, for a day. In Territories and among a population so vast, occasional disturbance must needs prevail. Raids and forays are, and will still be, reported from the Western Frontier. From time to time marauding expeditions will descend into the plains, and again expeditions to punish the marauders will penetrate the Hills. Nor can it be expected but that, among races so various and multitudes so innumerable, local outbreaks will from time to time occur, as little looked for as that of the Sonthal tribe in the Damun-i-koh.

But the rising of the Sonthal tribe has been repressed, and measures of precaution have been taken, such as may be expected to prevent all risk of its recurrence.

With respect to the Frontier raids, they are, and must for the present be viewed as, events inseparable from the state of society which for centuries past has existed among these mountain tribes. They are no more to be regarded as interruptions of the general peace in India than the street-brawls which appear among the every-day proceedings of a Police Court in London are regarded as indications of the existence of Civil War in England.

I trust, therefore, that I am guilty of no presumption in saying that I shall leave the Indian Empire in peace, without and within.

12. During the eight years over which we now look back, the British Territories in the East have been largely increased : within that time four Kingdoms have passed under the sceptre of the Queen of England, and various Chiefships and separate tracts have been brought under her sway.

13. The Kingdom of the Punjab and the Kingdom of Pegu were the fruits of conquest, which followed upon the Wars, whose origin and issue have been already stated.

14. The Kingdom of Nagpore became British Territory by simple lapse, in the absence of all legal heirs. The Kingdom, which had been granted to the reigning Raja by the British Government when it had become forfeited by the treachery of Appa Sahib, was left without a claimant when the Raja died. No son had been born to His Highness ; none had been adopted by him ; none, as they have themselves admitted, was adopted at the Raja's death by the Ranees, his widows. There remained no one male of the line who descended from the stock and bore the name of Bhonsla.

The British Government, therefore, refused to bestow the Territory in free gift upon a stranger, and wisely incorporated it with its own Dominions.

15. Lastly, the Kingdom of Oude has been assumed in perpetual government for the Hon'ble East India Company, in pursuance of a policy which has so recently been under the consideration of the Hon'ble Court that I deem it unnecessary to refer to it more particularly here.

16. The Principality of Sattara was included in the British Territories in 1849 by right of lapse, the Raja having died without male heir.

17. In like manner the Chiefship of Jhansie has reverted to the possession of the Indian Government.

18. Lastly, by a treaty concluded in 1853, His Highness the Nizam has assigned in perpetual Government to the Hon'ble East India Company the Province of Berar and other Districts of his State, for the permanent maintenance of the Hyderabad Contingent, for the payment of certain debts which he had incurred, and for the termination of those transactions which for many years had been the fruitful source of dispute, and had even endangered the continuance of friendly relations between the States.

|                                                                                                         |                   |
|---------------------------------------------------------------------------------------------------------|-------------------|
| 19. By the several territorial acquisitions which have just been enumerated, a revenue of not less than |                   |
| Punjab .....                                                                                            | £1,500,000        |
| Pegu (1856) .....                                                                                       | 270,000           |
| Nagpore (less tribute) ....                                                                             | 410,000           |
| Oude, .....                                                                                             | 1,450,000         |
| Sattara .....                                                                                           | 150,000           |
| Jhansie .....                                                                                           | 50,000            |
| Hyderabad, .....                                                                                        | 500,000           |
|                                                                                                         | <u>£4,330,000</u> |

From Returns and from Parliamentary Papers.

20. Stated in general terms, the revenue of India has increased from £26,000,000 in 1847-48 to £30,000,000 in 1854-55; and the income of the present year, exclusive of Oude, has been estimated at the same amount of £30,000,000 Sterling.

Without entering into any close detail, it may be stated that the main sources of revenue are not less productive than before; while the revenue derived from Opium has increased from £2,730,000 in 1847-48 to £4,700,000 in 1854-55, and is estimated at upwards of £5,000,000 for the present year.

21. The increase which has gradually and rapidly taken place in the external trade of India may be fairly estimated by the shipping returns of its principal port, Calcutta.

In 1847-48 there arrived in the Hooghly 625 vessels (exclusive of Native craft) amounting to 274,000 tons. In 1854-55 the number of vessels had increased to 866, and the tonnage to 481,000 tons ; while in the first ten months of the present year, there have already arrived 1,010 vessels of 556,000 tons. Thus, in these eight years, the tonnage which sought the Port of Calcutta has more than doubled in amount.

22. The facts which have been briefly stated above would seem to promise well for the financial prosperity of the country.

A measure which was carried into effect in 1853-54 was calculated to contribute further to that end. During those years the Five per cent. debt of India was entirely extinguished. Excepting the payment of a comparatively small sum in cash, the whole of the five per cent. debt was either converted into a Four per cent. debt, or re-placed<sup>d</sup> in the open Four per cent. loan. The saving of interest which was effected by this operation amounted to upwards of £300,000 per annum.

At a later period, by a combination of many unfavorable circumstances which could not have been anticipated, and which were not foreseen in England any more than by us in India, the Government has again been obliged to borrow at the high rate of five per cent. But the operation of 1853-54 was not less politic or less successful in itself, while the financial relief it afforded was timely and effectual.

23. During the years 1847-48 and 1848-49 the annual deficiency which had long existed still continued to appear in the accounts ; but in each of the four following years the deficiency was converted into a surplus, varying from £360,000 to nearly £580,000.

During the years 1853-54 and 1854-55 there has again been a heavy deficiency, and the deficiency of the present year is estimated at not less than £1,850,000.

But these apparent deficiencies are caused by the enormous expenditure which the Government is now annually making upon Public Works designed for the general improvement of the several Provinces of the Indian Empire. Therefore, a large annual deficiency must and will continue to appear, unless the Government shall unhappily change its present policy, and abandon the duty which I humbly conceive it owes to the territories entrusted to its charge. The ordinary revenues of the Indian Empire are amply sufficient, and more than sufficient, to meet all its ordinary charges ; but they are not sufficient to provide for the innumerable and gigantic works which are necessary to its

due improvement. It is impracticable to effect, and absurd to attempt, the material improvement of a great Empire by an expenditure which shall not exceed the limits of its ordinary annual income.

24. It is impossible, within the narrow bounds of a single Minute, to describe all the various changes that have been made, and the improvements that have been introduced, in the system of Indian administration, and its several subordinate departments, during the long period which is now being passed under review. A few leading facts can alone be recalled and marshalled in their order.

25. The several new Provinces whose Government we have assumed have been administered in tranquillity and with success.

The remarkable results which have attended the labors of the able First Punjab Report; and eminent men, to whom was committed the para 452. charge of the Province of the Punjab, are now familiar to Parliament and to the country. I feel it to be unnecessary to add even a single word to the Punjab Reports already submitted to the Hon'ble Court, which explain how "internal peace has been guarded—how the various establishments of the State have been organized—how violent crime has been repressed, the penal law executed, and prison discipline enforced—how Civil Justice has been administered—how the taxation has been fixed and the revenue collected—how commerce has been set free, agriculture fostered, and the national resources developed—how plans for future improvement have been projected—and lastly, how the finances have been managed."

26. In the Province of Pegu the results of our administration have been satisfactory in a high degree, though they have neither the brilliancy nor the interest which attaches to the labors of the local Officers in the Punjab.

But in Pegu also we have the satisfaction of knowing that, in spite of the peculiar discouragements and heavy difficulties with which our Officers have had to contend, complete tranquillity has long since been established. The people, lightly taxed and well to do, are highly contented with our rule : order and quiet prevail throughout the Districts : even in Tharrawaddy, which under the Burman rule was the permanent refuge of rebellion and crime, all outrage has ceased. The rivers, the great highways of the country, watched by an effective police, are tra-



versed in safety by all. Trade is rapidly increasing : a new port has been founded for the new European trade which has at once sprung up : and, light as taxation is, the revenue has already exceeded the amount at which I estimated its probable measure, for it is expected that twenty-seven lakhs will be collected this year.

Population alone is wanting. When that deficiency shall have been supplied, the Province of Pegu will equal Bengal in fertility of production, and will surpass it in every other respect.

27. The anticipations of those who believed that the renewal of British authority in Nagpore would be hailed with lively satisfaction by the whole population of the Province, have been more than fulfilled by the event.

The Raj was transferred by a simple order to the possession of the British Crown. Not one additional soldier was moved into the Province. Our Civil administration has been introduced into every District. Such portion of the Army as was required has been embodied and disciplined in our pay, while the rest have been pensioned, or discharged with a handsome gratuity. Perfect contentment and quiet prevail. Beyond the palace walls not a murmur has been heard, and in no single instance throughout the districts has the public peace been disturbed.

28. Equally happy results have attended the assignment which the Nizam was persuaded to make of the districts belonging to the State of Hyderabad.

In the possession of Berar and the neighbouring districts of Nagpore, the British Government, it deserves to be remembered, has secured the finest cotton tracts which are known to exist in all the continent of India ; and thus has opened up a great additional channel of supply, through which to make good a felt deficiency in the staple of one great branch of its manufacturing industry.

Since the assignment was made all disputes with the Nizam have ceased.

Though the Districts assigned were covered with places of defence—the famous fortress of Gawilghur among the rest—and although they were garrisoned by Arabs or Rohillahs, yet all were delivered over submissively and at once, and not a single shot was fired in anger.

There also the Civil administration has been introduced. Crime, especially the violent crime of dacoity, has already much diminished. The Revenue is already rapidly increasing. The public tranquillity has not been disturbed by even a single popular tumult ; and the admirable

little Army which was formerly the Nizam's Contingent, but which is now a British force, is available for any service for which it may be required.

29. The assumption of the Government of Oude is an event too recent to admit of any record being given of the progress that has been made towards the organization of its future administration. The Government of the Province was assumed on the 7th of this month. Up to the present time, no resistance has been attempted, no disturbance of the public peace has occurred. The troops of the King are contentedly taking service in our pay; and, thus far, at least, no Zemindar or Chief has refused submission to our authority.

A complete Civil administration had been prepared, and the military force which it was intended to retain had been fully organized, before negotiations were opened with the King. Officers had been named to every appointment. The best men that could be found available were selected from the Civil and Military Services for the new Offices in Oude, and the Government has every reason to anticipate that they will achieve an equal degree of success with those to whom similar tasks have previously been committed.

30. It is not, however, in the new Provinces alone that great changes have been brought to pass. When the Statute of 1833 expired, material and important changes were made by the House of Parliament upon the frame of the administration itself. Of these, two principal measures are worthy of note.

31. Until that time the local Government of Bengal had been placed in the hands of the Governor General of India. But in the year 1853, the system, by which the Officer charged with the responsibility of controlling the Government of all India was further burdened with local duties of vast extent and importance, was happily abandoned. The Governor General was finally liberated from the obligation of performing an impossible task, and a Lieutenant Governor was appointed to the charge of Bengal alone.

The importance of this measure cannot be over-rated.

32. At the same time another great change was introduced, equally novel in its character, and not less important.

A Council was appointed as the Legislature of India, which was no longer identical with the Supreme Council, but included divers other members, and exercised its functions by separate and distinct proceedings of its own.

The organization of the Legislative Council proved to be a work which involved great labor, and was attended with many difficulties.

The proceedings of the Council, however, were speedily reduced to form. The duties of the Council have subsequently been laboriously and faithfully performed. The public has long since had access to its deliberations. Its debates and papers are printed and published, and I trust and believe that Parliament and the public will each year see reason to be more and more content with the manner in which the Legislative Council of India will fulfil the purposes for which it was established.

33. Before proceeding to enumerate the measures that have been framed and carried into effect in connexion with the internal administration of the country, I am desirous of referring to some political incidents, which are not unworthy of note, although they did not seem to be of sufficient importance to find a place in the paragraphs allotted to the foreign relations of the Hon'ble Company.

34. Early in 1848, the Raja of Ungool, a petty Chieftain in the Jungle Mehals, resisted the authority of the Government. His Raj was taken from him, and he has since died in exile.

35. The Rajah of Sikkim, a Hill Chieftain on the borders of Nepal, in order to enforce certain claims which he alleged against the Government of India, had the audacity to seize the person of the Political Officer at Darjeeling, when travelling under the Raja's safeguard within his Dominions. Military preparations were made; the Agent was released; and all the Territories which the Raja possessed within the plains were confiscated and have been retained.

36. In Sinde, Meer Ali Moorad of Khyrpoor was accused of having forged a clause in a treaty whereby he had wrongfully obtained possession of lands which of right belonged to the British Government. A full and fair investigation was made. The Ameer had every opportunity afforded to him of defending himself, but his guilt was proved beyond a doubt. The lands were taken from him, and his power and influence were reduced to insignificance.

37. Upon the death of the Nawab of Bhawulpore, who had faithfully supported us in the contest with Moolraj, and to whom a pension of a lakh of rupees was granted as a reward, his second son was acknowledged as his successor, in accordance with the Nawab's request. Before very long, rebellion was raised against the new Nawab, and appeal was made to the British Government.

Nothing would have been easier for that Government than to have made terms by which direct and prospective advantage would have been gained for itself. The Government, however, refrained from all endeavour to aggrandise itself. It left to the Daoodpootras themselves to determine who should be their ruler, and when they had decided in favour of the eldest brother, the natural heir, the Government at once recognized him as Nawab, stipulating only for the safety of the deposed ruler, and accepting the custody of his person.

38. In like manner, when Jung Bahadoor had begged from the Nepalese Durbar the lives of his own brother and of the brother of the Raja of Nepal, who had conspired for the assassination of the minister, and when he obtained their lives only on condition that the British Government would undertake for their safe custody, the Government acting in the interests of humanity accepted the trust, though it was a dubious and responsible one.

39. When, not long since, Raja Jowahir Sing was engaged in open resistance to his uncle, Maharaja Golab Sing, the Government of India maintained a rigid neutrality.

Nothing would have been more easy than that the Government of India, while acting strictly within the obligations of Treaty, should have so framed its policy on this occasion as to place itself in a favorable position for drawing its own advantages from the contest which one day or other will probably arise between the members of the Jummoo family, and for perhaps recovering the fertile and unhappy Province of Cashmere, which in 1846 we unwittingly handed over to a Chief who has proved himself a veritable tyrant, and who already appears to be the founder of a race of tyrants.

But the Government of India was loyal both to the spirit and to the letter of its obligations, and stood wholly aloof from both contending parties.

40. Very lately the Nawab of Mumdot, who derived his independent powers from our gift, was accused of the grossest tyranny and of many personal atrocities. Full investigation was made, and the Nawab has been removed from power, and his Territory will be administered in trust for his family.

41. Seven years ago the heir apparent to the King of Delhi died. He was the last of the royal race who had been born in the purple. The Court of Directors was accordingly advised to decline to recognise

any other heir-apparent, and to permit the kingly title to fall into abeyance upon the death of the present King, who even then was a very aged man. The Hon'ble Court accordingly conveyed to the Government of India authority to terminate the Dynasty of Timoor whenever the reigning king should die.

But as it was found that, although the Hon'ble Court had consented to the measure, it had given its consent with great reluctance, I abstained from making use of the authority which had been given to me. The grandson of the King was recognised as heir-apparent, but only on condition that he should quit the Palace in Delhi, in order to reside in the Palace at the Kootub, and that he should as King receive the Governor General of India at all times on terms of perfect equality.

42. The Nawab Nazim of Bengal having permitted a cruel murder, by the infliction of bastinado, to be committed within his jurisdiction, and almost at the door of his own tent, His Highness' peculiar jurisdiction and legal exemption were taken away from him; and he was subjected to the disgrace of losing a large portion of the salute of honor which he had previously received.

43. During the last autumn the Nawab of the Carnatic very suddenly died.

As the Treaty by which the Musnud of the Carnatic was conferred on His Highness' predecessor was exclusively a personal one, as the Nawab had left no male heir, and as both he and his family had disreputably abused the dignity of their position and the large share of public revenue which had been allotted to them, the Court of Directors has been advised to place the title of Nawab in abeyance, granting fitting pensions to the several members of the Carnatic family.

44. Very shortly after the death of the Nawab of the Carnatic, the Raja of Tanjore deceased. He left no son, and no male heir, direct or indirect, who bore his name. The Hon'ble Court was therefore advised to resume the large stipend, which the Raja had enjoyed, as a lapse to the Government; pensions being granted to the members of the family, as in all similar cases.

45. In consequence of the proved existence of Khutput (that is of bribery and other undue influence) in connexion with the political affairs of Baroda at Bombay, the direction of the relations of His Highness the Guicowar with the British Government was transferred to the Governor General in Council. Since that time His Highness' affairs have ceased to give trouble or anxiety, and, so far as can be known,

no attempt to exercise Khutput has ever been made by His Highness' agents, or by Goozerattee intriguers, at Calcutta.

All the States in Central India have been placed under the control of a Governor General's Agent for Central India, with the same advantage which attended a similar measure within Rajpootana.

46. There are two incidents connected with the families of Native Princes, which remarkably signalise the period we are now reviewing, though they may not be regarded as of political moment.

47. The first is the adoption of the Christian faith by Maharaja Duleep Sing, the last of the rulers of the Punjab. The act was voluntary on the part of the boy, and, under the guidance of God's hands, was the result of his own uninfluenced convictions.

It is gratifying to be able to state, that his life hitherto has been strictly consistent with the injunctions of the faith he professes.

48. The other incident is of a similar character. I refer to the Christian baptism of the daughter of the Ex-Raja of Coorg, under the special protection of Her Majesty the Queen. The desire for the baptism of the young Princess proceeded from the Raja himself, and was intimated to me so early as in 1848.

49. The catalogue of the changes and improvements which have been effected, and of the measures that have been taken, under various heads in the several branches of the Civil administration, during the last eight years, is happily a long one.

It commences with the re-organization of the Civil Service itself.

50. By the statute which was passed in 1853 to provide for the Government of India, admission to the Indian Civil Service was thrown open to all who, being natural-born subjects of the Queen, should offer themselves as candidates for examination and admission.

This change of system, comprehensive in its principle and momentous in its consequences for good or for ill, is still an experiment whose result remains to be seen.

51. Before this large step was taken by the Imperial Parliament, new and stringent rules had been introduced by the Government of India for increasing the efficiency of the Officers of the Civil Service.

The unnecessarily protracted period which was allowed for study to every young Civilian, before he presented himself for the examination which was to test his fitness for entering on active duties, was much

curtailed. Instead of allowing for that purpose twenty-two months, during which the young gentlemen had usually idled and loitered at the Presidency, the Government now requires that every Civilian shall pass an examination in two languages within six months after his arrival. If he should fail to do so, he is not allowed to remain at the Presidency, but is sent into the Mofussil to continue his studies there.

These rules have been extended to all the several Governments.

52. Periodical examinations of the Covenanted Assistants in the several branches of the administration have been established. Every Assistant is required to pass each of these successive examinations before he receives promotion to a higher grade in the Civil Service.

A similar system of examinations has been established for the Uncovenanted Officers whom the Government employs.

It is believed that the regulations just described have been productive of the best effect.

53. Simultaneously with those measures, the College of Fort William, which was established by the wisdom of Lord Wellesley, but which seemed no longer adapted to the purposes it was intended to serve, and which had indeed become a mere name, was abolished.

A Board of Examiners for conducting examinations, and for superintending the studies of young Civilians, has been created in its stead.

54. All Officers of the Government have been prohibited from engaging or taking any part whatever in the management of Banking and Trading Companies.

54 A. It has been ordered by the Hon'ble Court, that in the event of any of their servants, Civil or Military, resorting for relief to the Insolvent Court, they shall be suspended until the pleasure of the Court shall be made known.

54 B. After several references and modifications, a complete set of Civil Absentee Rules has been substituted for those which were published in 1843. It is hoped that they will be found advantageous at once to the members of the Civil Service and to the interests of the Hon'ble Company.

55. The following are improvements that have been introduced into the frame of the administrative departments.

56. In the Non-Regulation Provinces a principle has been established, whereby the whole body of Civil Officers is distributed into classes of varying size and numbers. The promotion from class to class is

regulated by merit, not by seniority. Undoubted benefit has arisen from this change.

57. Effect has been given to this principle in the Uncovenanted Service of Government.

The system of promotion from grade to grade was formerly regulated by length of service. It gave to each Officer promotion, as a matter of course, after he had served a certain number of years. Promotion by merit is now the rule.

In Bengal and in the North-Western Provinces the Uncovenanted Officers in the Opium Department, the Deputy Collectors, the Deputy Magistrates, and Abkaree Superintendents, have been arranged in classes, on different rising salaries. Merit alone will now raise an Officer from a lower to a higher among these classes.

The superiority of the new system must be obvious at a glance.

58. In addition to these improvements in the terms of service under which the large and valuable body of Uncovenanted Officers is employed in India, there are others which remain to be noticed.

The benefits of the Pension Rules have been conceded to the Officers of the Education Department. This boon has been extended to the Uncovenanted Officers of the Public Works Department, and to those of the Bengal Steam Service.

Furthermore, a set of Absentee Rules for the Uncovenanted Service has been prepared, and has been submitted for the confirmation of the Hon'ble Court.

59. Formerly in the Lower Provinces two separate Boards, each consisting of two Members, had the management, one of the Revenue of Customs Salt and Opium, the other of the general Revenue. The effect of their peculiar constitution was to impose upon the Government the necessity and the labor of deciding in every one of the numerous cases in which the two Members of each Board might chance to differ in opinion.

The separate Boards were abolished ; and one Revenue Board of three Members was created in their room.

60. A scheme of reform of the Secretariat and of the Administrative Departments at Bombay, which was submitted by the Government of that Presidency, has been sanctioned, with some temporary reservations.

61. An Accountant General has been appointed in immediate connexion with the Supreme Government.



62. For some time past very earnest endeavours have been made to expedite the preparation and despatch of the Reports on the Sketch and regular Estimates, and of the Statements of actual Receipts and Disbursements in each year.

It is believed that in future years the wishes of the Home Authorities will be completely met. The Sketch Estimate of 1855-56 was sent on 22nd October 1855. It is expected that the regular Estimate of 1855-56 will be sent in May 1856; and that the actual Statement of 1855-56 will be made up in December 1856.

63. It has however been long felt by the Supreme Government that the information which was given, as to the condition of the Indian finances in each year, by the Reports which accompanied the Estimates of the year, was cumbrous, obscure and insufficient. Wherefore, in order to enable the Government of India to take a formal and clear review of its financial position, at regular intervals, it was lately directed that, in addition to the Reports which are annually prepared by the Financial Secretary to accompany the Sketch and regular Estimates and the Accounts of actual Receipts and Disbursements, the Secretary should in future, once in each year, at the time of the submission of the regular Estimate, prepare a separate Report, pointing the attention of the Government in this country and at home to any notable changes in the income from material sources of Revenue, and affording such explanation of the cause as is to be given, noticing where and how any material increase or reduction of expenditure has been made, and submitting generally an exposition of the prospects of the coming year founded upon an intelligible analysis of the results of the year under review.

64. In the year 1854, it was represented to the Hon'ble Court of Directors that in the circumstances of the present day it was unnecessary to maintain any longer the Office of Government Agent. The business of the Government Agent, (the whole of the property in whose hands was private property, not liable to the jurisdiction of the Government, and in cases of dispute tangible by law only,) consisted in buying and selling Government Securities for whoever thought proper to employ him. These and similar functions seemed no part of the duty of a Government Officer; nor was there any reason why the Government of the country should continue to act any longer as a private Agent.

Accordingly, the consent of the Hon'ble Court was given to the abolition of the Government Agency at the end of the present year.

65. By the Statute of 1853, the salary of each Member of the Supreme Council was fixed at Rupees 80,000 per annum. The salary of each Member of the Legislative Council was fixed at Rupees 50,000 per annum. Guided by this standard the Government has ruled, that no salary in India, shall exceed 50,000 Rupees a year, with some few and specified exceptions.

66. Under the orders of the Hon'ble Court a Special Commissioner has recently been appointed, for the purpose of executing the revision, which the Hon'ble Court had required the Government to make, of all Civil Salaries throughout the Indian Territories.

67. Two great subjects, which command the deepest interest and attention in England, have received, during these years in India, a large measure of consideration and practical development—I mean Prison Discipline and Education.

It was in the North-west Provinces, under the administration of Mr. Thomason, that the first effectual effort was made for the improvement of Prisons and Prison Discipline.

The appointment of an Inspector of Prisons within that jurisdiction was found to be so beneficial in all respects, that a similar Office was created in Bengal. The Governments of Madras and Bombay have since been authorised to establish the Office within their respective Presidencies. It has long since been found necessary to employ an Officer in that capacity for the Non-Regulation Province of the Punjab, and the advantage which would have been derived from possessing the control of such an Officer there from its first annexation having been made apparent, the Government has profited by experience, and has included an Inspector of Prisons among the necessary administrative Officers of the Province of Oude.

In connection with this subject it may be added that the punishment of transportation to the Colonies having been abolished in respect of all civil European prisoners, measures have been taken for preparing a general Prison for persons of that class convicted in India.

68. Until of late years the progress of Education in India, under the auspices of the several Local Governments, must be admitted to have been languid and inconsiderable.

It received its first great impulse, as a general system, from the hand of the late Mr. Thomason, who obtained permission to establish a Government School in every Tehsildaree within eight Districts in Hindoostan. The measure was declaredly experimental ; but it was attended with such signal success, that in 1853, the Government of India very earnestly recommended that the system of Vernacular Education, which had proved so effectual, should be extended to the whole of the North-Western Provinces. Not only was this large measure recommended for immediate adoption, but similar measures were advised for the Lower Provinces of Bengal and for the Punjab, with such modifications as their various circumstances might be found to require.

The Supreme Government did not fail to give its attention to the subject of Vernacular Education in Bombay and Madras, in the former of which some progress has been made.

About the same period the Hindoo College and the Mudrissa in Calcutta were revised and improved.

In connection with them the Honorable Court was requested to sanction the establishment of a Presidency College at Calcutta, which should be open to all classes of the community, and which should furnish a higher scale of Education, especially of English Education, to the youth of Bengal, than was supplied by any existing Institutions.

The establishment of the College has since been sanctioned.

While the proposals for that Institution, and for the extension of Vernacular Education, were still before the Home Authorities, the Honorable Court addressed to the Government of India their great Education Despatch dated 19th July 1854. It contained a Scheme of Education for all India, far wider and more comprehensive than the Local or the Supreme Government could ever have ventured to suggest. It left nothing to be desired, if indeed it did not authorise and direct that more should be done than is within our present grasp.

Vernacular Schools throughout the Districts, Government Colleges of a higher grade, and a University in each of the three Presidencies of India, were the main features of this great plan.

The bestowal of Grants-in-Aid on all Educational Institutions was also sanctioned, subject to certain rules, and on the condition of Government inspection being at all times and fully admitted.

Immediate steps were taken in India for giving effect to the orders of the Honorable Court.

A distinct department for the superintendence of Education was constituted. A Director of Public Instruction has been appointed by each Governor and Lieutenant-Governor, and in the Punjab ; and suitable aid by Inspectors and others has been allotted to each of them.

Provisional Rules for regulating Grants-in-Aid have been sanctioned for the guidance of the several Local Governments.

Lastly, a Committee has been appointed for the purpose of framing a Scheme for the establishment of Universities at the Presidency Towns of Calcutta, Madras, and Bombay. It is still engaged in its difficult task.

69. In its general Educational projects the Government has not lost sight of a collateral object, full of peculiar interest, namely, the Education of the Females of India.

In 1850, at the suggestion of the late Mr. Bethune, then the President of the Council of Education, that body was instructed by the Government of Bengal to consider their functions as henceforth extending to the Superintendence of Native Female Education, and that, whenever any disposition was shown by the Natives to establish Female Schools, it would be their duty to give them all possible encouragement.

The Court of Directors, in their Despatch already referred to, observed that the importance of Female Education cannot be over-rated ; and they expressed their cordial sympathy with the efforts which had been made for its encouragement and extension.

It is well known that, among the many difficulties which have stood in the way of educating the females of India, none has been more obstructive than the reluctance which has always been shown by the higher classes of Natives to consent to permit the attendance of their daughters in schools. The late Mr. Bethune endeavoured to meet this difficulty at the Capital, by founding a school for the especial instruction of the female children of Natives of wealth and rank. It began with very small beginnings, but the influence, the liberality, and the perseverance of its founder enabled him to achieve and to witness a certain success in his labors.

His unexpected and lamented death, in 1851, seemed likely to be fatal to the benevolent and novel undertaking in which he had engaged. Unwilling that any chance of success in so desirable an object should be lost, I adopted and have myself supported the School from the time of Mr. Bethune's death until now.

Though it has struggled on but slowly, its progress has been steady and still continues. The attendance has gone on increasing, until there are now more than fifty scholars attached to the School.

By means of funds which were left by Mr. Bethune, an excellent School-house and all requisite buildings have been constructed in Cornwallis Square. Every thing, as I leave it, promises well; and as the Hon'ble Court has been pleased to take upon itself the pecuniary maintenance of the School in future, I trust that such special interest will be shown in the undertaking, by those of rank and influence on the spot, that its future progress will be insured, until it shall have acquired an extent and stability which will enable it to fulfil the high purposes for which its founder, Mr. Bethune, designed it.

70. While it is gratifying to me to be thus able to state that the moral and social questions which are engaging attention in Europe have not been neglected in India during the last eight years, it is doubly gratifying to record, that those years have also witnessed the first introduction into the Indian Empire of three great engines of social improvement, which the sagacity and science of recent times had previously given to the Western Nations—I mean Railways, Uniform Postage, and the Electric Telegraph.

I propose to advert to each of them, briefly, in their order.

71. The subject of Railway communication in India was first laid before the Supreme Government by Mr. Macdonald Stephenson, in 1843.

In 1849 the Hon'ble Company engaged in a Contract with the East Indian Railway Company, for the construction of an experimental line at a cost not exceeding one million Sterling. The line was to be selected with a view to its forming a portion of a future trunk line to the North-Western Provinces.

On that ground the section from Howrah towards Rajmahal was chosen, with a branch to the Coal field at Ranecgunge.

In the cold weather of 1851, a line was surveyed between Burdwan and Rajmahal. In the following season that survey was continued to Allahabad.

In the Spring of 1853 the Government of India submitted to the Court of Directors its views upon the general question of Railways for the Indian Empire.

The Hon'ble Court was respectfully advised to encourage the formation of Railways in India to the utmost. It was urged not to hesitate to engage in the enterprise upon a scale commensurate to the vast extent of the Territories which had been placed under its Government, and to the great political and commercial interests which were involved.

It was specifically recommended that, in the first instance, a system of trunk lines should be formed, connecting the interior of each Presidency with its principal port, and connecting the several Presidencies with each other.

The trunk lines which were proposed, and of which the general direction could alone be given, were,—

1st,—A line from Calcutta to Lahore.

2nd,—A line from Agra, or some point in Hindostan, to Bombay, or alternatively a line from Bombay by the Nerbudda Valley to meet at some point the line from Calcutta to Lahore.

3rd,—A line uniting Bombay and Madras.

4th,—A line from Madras to the Malabar Coast.

The Hon'ble Court was pleased to give its approval to the general plan which the Supreme Government had sketched.

Some progress has already been made in the construction of most of these lines; and measures have been taken for the construction of them all in due course of time.

In the Bengal Presidency, the line from Calcutta to Raneegunge, a distance of 120 miles, was opened on the 3rd February 1855.

The Court of Directors has sanctioned the construction of a line from Burdwan to Delhi, on a capital of £10,000,000 Sterling.

The direction of the line from Burdwan to Allahabad having been previously approved, that from Allahabad to Cawnpore was sanctioned in June 1854, from Cawnpore to near Agra in December 1854, and thence *viâ* Agra and Muttra to Delhi in November 1855.

Surveys of two alternative lines from Delhi or Agra to Lahore were executed in 1854-55: additional surveys have been authorized from Mirzapore to Jubbulpore, and from Cawnpore to Bhilsa.

It has been stated above that the trunk line from Calcutta to Burdwan, with a branch to Raneegunge, has already been opened.

It is expected that the section of this trunk line which lies between Mirzapore and Agra (except the bridge over the Jumna at Allahabad)

will be completed by the end of 1857; and arrangements are in progress for opening this portion of the line separately.

It is further expected that the section between Burdwan and Rajmahal will be completed in 1858, and the remainder probably not till 1859.

In the Bombay Presidency the Hon'ble East India Company has recognized and made engagements with two Railway Companies for executing the several lines proposed; the first, the Great India Peninsula Railway Company; the second, the Bombay, Baroda and Central India Railway Company.

In 1849 a contract was entered into with the former, for constructing an experimental line from Bombay towards the Ghâts.

The first section of the Bombay line, which was the first line of Railway employed for public traffic in India, was opened on 16th April 1853.

A length of fifty-one miles on this line, from Bombay to Wasingdra, has been open since October 1855.

After much discussion, and many surveys, in regard to the competing lines for the traffic between Candesh and Bombay, (the one proposed by the Great India Peninsula Railway Company, direct, by the Thull Ghât in the Syhādree Range—the other proposed by the Bombay, Baroda and Central India Railway Company, circuitous, by way of the Taptee Valley,) the Government of India was enabled to form a well-founded conclusion in the autumn of 1855. The Supreme Government recommended that the line from Bombay to Candesh by way of the Thull Ghât should be sanctioned by the Hon'ble Court as a highly important local line.

At the end of the year the Supreme Government recommended further, that an extension of this line from Candesh to Nagpore should receive the sanction of the Hon'ble Court.

Thus direct and easy and cheap conveyance will be afforded to the magnificent port of Bombay, not only for the produce of the rich province of Candesh, but for all the raw cotton of the famous districts of Berar and Nagpore, to whose value allusion has already been made in a previous paragraph of this Minute.

Surveys have also been executed for this Company from Candesh to the Iron and Coal Districts on the Nerbudda, and as far as Jubbulpore, where they will meet the survey already mentioned from Mirzapore.

In December 1854, the Supreme Government recommended to the Hon'ble Court to give its sanction to the line from Bombay by the Bhoore Ghât to Poona, as the first section of the trunk line from Bombay to Madras.

In the autumn of 1855, the Hon'ble Court was advised to sanction the prolongation of this line from Poona as far as the River Kistna, where it is intended to meet the trunk line from Madras.

In November 1854, the Government of India resolved to recommend to the Court of Directors to give its sanction to the line which had been surveyed by the Bombay, Baroda and Central India Railway Company from Bombay to Baroda and Ahmedabad, and which was intended to form the first section of a trunk line from the Western Coast of India to Hindostan.

The Hon'ble Court was pleased to approve of the section from Surat to Ahmedabad, but it withheld, for the time, its sanction to the section between Surat and Bombay.

The line of junction which should be selected between the Presidency of Bombay and Hindostan has been found beset with difficulties. But in the very last hours of my administration, I have had the satisfaction of receiving plans and sections, which appear to show that a very practicable and eligible line may be found from Baroache over the Ghâts to Indore, and thence by Bhilsa and Gwalior to Agra. I trust that this line, forming an excellent junction between Bombay and Hindostan, and giving easy access to the rich products and important trade of Central India may ultimately be adopted.

In the Madras Presidency all the Railway engagements of the Hon'ble East India Company have been formed with the Madras Railway Company.

A line from Madras by Vaniembaddy, Salem, and Coimbatore, to Poonany on the Malabar Coast, was sanctioned by the Hon'ble Court.

No portion of this line has been opened as yet for public traffic; but I had the satisfaction of travelling upon it for about fifty miles in November last, and I saw every reason to approve of the execution of the line, and of the vigour with which the works were being carried on.

Sanction has also been given by the Hon'ble Court to a branch line from Vaniembaddy to Bangalore.

Two plans have been proposed for the trunk line which is to unite the Presidencies of Madras and Bombay.

The one line would proceed by Cuddapah and Bellary to the River Kistna the other would form a continuation of the line first mentioned, and would be carried from Bangalore to Bellary, and thence to the River Kistna.



The Supreme Government has given the preference to the trunk line by way of Cuddapah, and has referred the question for the final decision of the Hon'ble Court.

It seems to me that the Hon'ble Court have every reason to be satisfied with the progress that has been made in the construction of Indian Railways since 1849, and with the prospect of future return.

72. The inferiority of the Postal system in India, and the unsatisfactory manner in which the Post Office Department had been found to work in every Presidency, induced the Supreme Government, in the year 1850, to appoint a Commission, consisting of one member from each Presidency, to examine into the Post Office system and to report on some scheme for its improvement.

The Report prepared by the Commission was submitted for the consideration of the Hon'ble Court of Directors. It resulted ultimately in the adoption of the following principal changes and improvements in the Indian Postal system :—

1st,—The institution of the Post Office throughout India as a distinct department, superintended by the “ Director General,” under the immediate control of the Government of India.

2nd,—The establishment of an uniform single rate of Postage, of half-an-anna ( $\frac{3}{4}d.$ ) for letters, and of an anna ( $1\frac{1}{4}d.$ ) for newspapers, few irrespective of distance.

3rd,—The substitution of Postage Stamps for cash payments.

4th,—The restriction of the privilege of official franking to as Officers as possible.

Very recently Her Majesty's Government have consented to the adoption of an uniform rate of Postage, payable in one sum, on letters between England and India. The rate has been fixed at six pence per half ounce.

As yet, it is too soon to form any correct estimate of the actual effect of these changes upon the amount of general correspondence and upon the public revenue. So far as we may venture to form a conjecture, the increase in correspondence has already been at the rate of 25 per cent., while the loss of revenue has been less considerable than was expected.

On the other hand, it would be difficult to form any conception at all of the real magnitude of these changes and of their social effects, unless by illustration and contrast. Two simple facts may perhaps enable a

bystander to estimate in some degree the extent of our Postal reform and its value.

In England a single letter is conveyed to any part of the British Isles for a penny : in India a single letter is now conveyed over distances immeasurably greater, from Peshawur on the borders of Affghanistan to the southernmost village by Cape Comorin, or from Debrooghur in Upper Assam to Kurrachee at the mouth of the Indus, for no more than three farthings. The postage chargeable on the same letter three years ago in India would not have been less than a shilling, or sixteen times the present charge.

Again, since uniform rates of Postage between England and India have been established, the Scotch recruit, who joins his regiment on our furthest frontier at Peshawur, may write to his mother at John O'Groat's House and may send his letter to her free for a sixpence. Three years ago the same sum would not have carried his letter beyond Lahore.

It has rarely happened that a departmental revolution so complete, having consequences so wide-spread and so generally beneficial, could be recorded in so few lines as have now sufficed to exhibit the reform of our Indian Post Office and its excellent results.

73. It was in the beginning of April 1852, that the Report of Dr. W. O'Shaughnessy, on the full completion, and the successful working, of the experimental line of Electric Telegraph, which had previously been authorised by the Hon'ble Court, was laid before the Government of Bengal. On the 14th of that month the Governor of Bengal strongly urged the Governor General in Council to obtain the sanction of the Hon'ble Court to the immediate construction of lines of Electric Telegraph from Calcutta to Agra, to Bombay, to Peshawur, and to Madras. He also advised that Dr. O'Shaughnessy should be forthwith sent to England for the furtherance of the measure. On the 23rd of the same month, the Governor General in Council recommended these measures to the Court of Directors, and Dr. O'Shaughnessy proceeded to England.

The Hon'ble Court entered into the proposal with the utmost cordiality and promptitude, and on 23rd June it signified its assent to the whole proposal of the Government of India.

During the rest of that year, and through the greater part of the next year, Dr. O'Shaughnessy was employed in procuring and dispatching from

England the immense mass of materials which was required for the vast work which had been projected.

In November 1853, the construction of the Telegraph line from Calcutta to Agra was commenced. On the 24th March 1854, a message was sent over the line from Agra to Calcutta, a distance of 800 miles, which had been completed in less than five months.

The vigour which was thus apparent at the commencement of the work was fully maintained throughout all its subsequent progress. On the 1st February 1855, fifteen months after the commencement of the work, the Superintendent was able to notify the opening of all the lines from Calcutta to Agra, and thence to Attock on the Indus, and again from Agra to Bombay and thence to Madras. These lines included forty-one Offices, and were extended over 3,050 miles of space.

Nor is this all. Since the commencement of the past year the line of Electric Telegraph has been completed to Peshawur. It has been extended from Bangalore to Ootacamund; and is nearly finished from Rangoon to Meeaday upon the Burmese Frontier.

To sum up in a single sentence. The Superintendent has stated in his last Report that 4,000 miles of Electric Telegraph have been laid down, and placed in working order, since the month of November 1853.

The difficulties which have been encountered in the construction of the Indian Telegraph lines were such as have no existence in the civilized and cultivated countries of Europe.

Throughout Central India, for instance, Dr. O'Shaughnessy states,—  
 Report 9th Feb. 1856;      "The country crossed opposes enormous difficulties  
 para. 27.      "ties to the maintenance of any line. There is no  
 "metalled road; there are few bridges; the jungles also in many places  
 "are deadly for at least half the year; there is no police for the protection  
 "of the lines. From the loose black cotton soil of Malwa to the rocky  
 "wastes of Gwalior, and the precipices of the Sindwa Ghâts, every variety  
 "of obstacles has to be encountered."

On the lines that have been mentioned, about seventy principal rivers have been crossed, some by cables, others by wires extended between masts.

Some of these river-crossings have been of great extent. The cable across the Soane measures 15,840 feet; and the crossing of the Toombudra River is stated to be not less than two miles in length.

The cost of constructing the Electric Telegraph in India cannot yet be accurately calculated. The Superintendent in his last Report has stated it as his belief, that the "total cost of everything, construction of 4,000 miles as they at present stand, working of all the offices for two years, spare stores in hand, instruments, houses, &c." will not exceed twenty-one lakhs of rupees, or little more than 500 Rupees a mile.

It is to be observed that the construction of the line, though rapid, is for the most part already substantial. The Superintendent states, that the line "for three-fourths of the distance from Madras to Calcutta is superior in solidity to any ever erected elsewhere."

On some portions of its length, it stands without a rival in the world. For instance, in the Madras Presidency, the line for 174 miles is borne on stone masonry pillars capped with granite; while for 332 miles it is sustained "on superb *granite*, 16 feet high above ground, in single slabs."

It is satisfactory to be able to add, that the Superintendent has officially stated that the Tariff of charges on the Indian lines "is now as cheap as that in use in any other country having lines of such length as permit a fair comparison with ours."

Thus it is stated that in England a message of 20 words, sent 400 miles, would be charged five shillings. The charge in India for 24 words to Benares, 420 miles, is three shillings.

Again, in the lines on the Continent of Europe, a message of 24 words sent from London to Trieste, would cost 22 shillings. A similar message of 24 words sent from Calcutta to Bombay (about the same distance, 1,600 miles, as from London to Trieste) would be 12 shillings.

\* For a comparison of the charges for greater distances than these, we must look to the United States of America.

The Superintendent states, that a message of 16 words, sent from New York to New Orleans, 2,000 miles, would cost 13 shillings and 6 pence. A similar message of 16 words, sent from Calcutta to Bangalore, which is more than 2,000 miles, costs only ten shillings.

Allusion has been made to the physical difficulties which obstructed the formation of the Telegraph lines in India. But these were by no means the most serious difficulty with which the Superintendent has had to contend. An entire establishment for the working of the lines was to be formed from the commencement, and the materials from which to form it were scanty, and by no means of the best description.

Hence the Superintendent states, even in his last Report, that his Report 9th Feb. 1856; "chief and almost insurmountable difficulty" has para. 100. lain in the sudden and simultaneous training of some 300 persons, employed in sixty different offices. And while the Superintendent affirms that the signallers generally are expert and capable of accurate manipulation, yet in respect of steadiness and other requisite qualities he records that there is both room and need for great improvement.

I could myself bear testimony to the accuracy and rapidity with which the Telegraph is worked, but I prefer to quote the recorded statements of the Superintendent.

Referring to allegations of inaccuracy in the Telegraph Department, the Superintendent observes—"I can further establish by facts and "official records beyond dispute, that the Indian lines have already "accomplished performances of rapidity in the transmission of intelligence, which equal that achieved on the American lines.

"We have repeatedly sent the first bulletin of overland news in 40 Report 9th Feb. 1856; "minutes from Bombay to Calcutta, 1,600 miles. para. 78. "We have delivered despatches from Calcutta to "the Governor General at Ootacamund, during the rainy season, in three "hours, the distance being 200 miles greater than from London to Sebastopol. We have never failed for a whole year in delivering the mail "news from England *viâ* Bombay within twelve hours."

The Superintendent has been permitted by the Hon'ble Court to proceed a second time to England and to America, to obtain the means of improving our present system and of extending it still further. \*

Several new lines are in contemplation within India itself.

The Supreme Government has further expressed its readiness to co-operate with the Government of Ceylon in extending the Indian lines from the Presidency of Madras to Point de Galle.

And, as the Hon'ble Court has indicated its willingness to join in any practicable scheme for laying down a Submarine Telegraph across the

Mediterranean and the Indian Seas, it may be hoped that the system of Electric Telegraphs in India may yet one day be united with those which envelope Europe, and which already seek to stretch across the Atlantic Ocean.

It is not the object of the Government of India to derive any surplus revenue from its Telegraph establishment. If, Report 9th Feb. 1856; para. 7. therefore, mention is here made of the financial results of the year, it is only for the purpose of showing the important fact, that increasing resort is made to the Telegraph for the transaction of private business throughout the country. The Superintendent states, that the "monthly cash receipts have, even in the first year, very largely exceeded the sum anticipated (namely 10,000 Rupees), and that they "exhibit a steady and constant increase from month to month."

The Political and the Military advantages which the Government of the country derives from the possession of such an engine of power are too obvious to call for notice. But two remarkable instances of its efficacy, which have fallen within my own immediate knowledge, will afford an illustration of its political value, which will not be without interest.

When H. M.'s 10th Hussars were ordered with all speed from Poona to the Crimea, a message requesting instructions regarding their despatch was one day received by me at Calcutta, from the Government of Bombay, about nine o'clock in the morning; instructions were forthwith sent off by the Telegraph in reply, and an answer to that reply was again received at Calcutta from Bombay in the evening of the same day. A year before, the same communications, for the despatch of speedy reinforcements to the seat of war, which occupied by the Telegraph no more than twelve hours, could not have been made in less than thirty days.

The other instance is of a similar character :—

When it was resolved to send Her Majesty's 12th Lancers from Bangalore to the Crimea, instead of Her Majesty's 14th Dragoons from Meerut, orders were forthwith despatched by Telegraph direct to the Regiment at Bangalore.

The Corps was immediately got ready for service. It marched 200 miles to Mangalore, and was there before the transports were ready to receive it.

In both cases the effect was the same. The Electric Telegraph enabled the Authorities in India to give to Her Majesty's Government,

in its hour of need, two magnificent Cavalry Corps of not less than 1,300 sabres; and to despatch them to the Crimea with a promptitude and timely alacrity which exceeded all expectations, and which in the circumstances of the previous year would have been utterly impracticable.

NOTE.—I venture to add another and a recent instance of the political value of the Electric Telegraph, which has occurred since this Minute was signed.

On the 7th February, as soon as the administration of Oude was assumed by the British Government, a branch Electric Telegraph from Cawnpore to Lucknow was forthwith commenced. In eighteen working days it was completed, including the laying of a Cable, 6,000 feet in length, across the River Ganges.

On the morning on which I resigned the Government of India, General Outram was asked by Telegraph, "Is all well in Oude?"—The answer, "All is well in Oude," was received soon after noon, and greeted Lord Canning on his first arrival.

(Signed) D.

I have now given a brief history of the construction of the working and of the results of the Electric Telegraph in India.

In the Minute in which, as Governor of Bengal, I first proposed the construction

of a general system of Telegraphs to the Governor General in Council, it was observed, "Everything, all the world over, moves faster now-a-days than it used to do, except the transaction of Indian business."

Whoever shall peruse the paragraphs that have just been written Minute, 14th April 1852, p. 9. will be ready to admit, that, so far as the Electric Telegraph is concerned, the reproach of tardiness has been removed.

Furthermore, I make bold to say that, whether regard be had to promptitude of executive action, to speed and solidity of construction, to rapidity of organization, to liberality of change, or to the early realization and vast magnitude of increased political influence in the East, the achievement of the Hon'ble Company in the establishment of the Electric Telegraph in India may challenge comparison with any public enterprise which has been carried into execution in recent times, among the Nations of Europe or in America itself.

74. Although conspicuous place has been given to those great measures of public improvement, on which I have dwelt in the preceding paragraphs at a length which only their great importance and value will justify, many measures remain to be told which are well worthy of note, in connexion with the commerce, the resources, the products, the communications, and the general improvement of the country.

75. In connexion with Commerce and Navigation, it may be mentioned, that, within the last eight years, differential duties on foreign bottoms have been abolished.

The Coasting trade of India has been set entirely free.

An Act has been passed for the discouragement of Crimps and for the Registry of British Seamen.

The duties levied in the Ports of India were already so light, that there has been little inducement to touch the Tariff, unless it had been for the purpose of enhancing the rates in justice to the general revenue of India.

The Tariff, however, has been in some degree simplified; and its operation has been extended to the ports in the Provinces of Tenasserim, Arracan and Pegu.

Restriction on the Salt trade of the North-Western Provinces has been removed.

76. Early in 1854, a Commissioner was appointed to investigate and report upon the whole question of the manufacture and sale of Salt in India.

The appointment of the Commissioner was made with especial reference to the question of the practicability of controlling the manufacture of Salt in Bengal by means of a system of Excise.

It has been a cause of just dissatisfaction to the Supreme Government, that the submission of the Report on this subject has been so long delayed, and that it has only just been transmitted to the Home Authorities by the Commissioner, Mr. Plowden, and even now in an imperfect state.

In the mean time the sanction of the Supreme Government has been given to an experiment being made under the authority of the Lieutenant-Governor of Bengal, for the manufacture of Salt, in one District within his jurisdiction, under a system of Excise. The experiment is still in progress.

77. A duty on the import of raw cotton into the North-Western Provinces has been abolished.

The Frontier customs duties in the Punjab having been found to be a cause of vexatious oppression to the population, while the sum they gave to the Treasury was comparatively inconsiderable in amount, they were wholly abolished; and their place was supplied principally by a Tax on Salt from the Mines.



At the same time the duty on the Salt taken from the Trans-Indus mines was made exceedingly light: the object there being, not the realization of Revenue, but the maintenance of tranquillity and of an effectual control over the interests and the conduct of the Hill tribes.

In like manner, and for similar reasons, all Customs and all Export duties upon the River Indus were abandoned; and ultimately the Land Frontier Customs were abolished in Sinde, as they had previously been in the Punjab.

Upon the same principle the Land Frontier Customs between the Territories of His Highness the Nizam and the British Provinces which surround it have been wholly given up, and are no longer levied upon any part of the Frontier.

78. While efforts have thus been made, in various provinces of the Empire, to give full freedom to the course of trade, the Government of India has been sedulous in originating and encouraging endeavours to discover and bring to use the hidden resources of the Indian Territories.

79. The great acquisition which has been made by the possession of the Cotton districts of Berar and Nagpore has already been noticed.

Attention has also been given to the cotton which is produced in the Upper Districts of Pegu. A gentleman, having practical knowledge of the subject, was deputed to examine the Districts beyond Prome and Thayet Myo. His report, although ineagre, was encouraging in a certain degree.

80. The cultivation of Tea in Assam has prospered in a remarkable degree.

The plant has also been largely introduced into the Upper Districts of the North-West Provinces. Some years ago plantations were established in the Deyrah Dhoon and in Kumaon and Gurhwal.

More recently Mr. Fortune has been employed to bring plants and seeds in large quantities from China, and to engage Chinese workmen for the manufacture of the tea.

The cultivation has extended along the Himalayas. Extensive plantations are now growing up on the heights towards Kangra, and an experimental plantation has been formed on the Murree Hills above Rawul Pindie. Further to the Eastward, in Kumaon and

Gurhwal, the Zemindars have adopted the cultivation of the plant themselves.

Very large quantities of tea are now manufactured every year. It sells readily, at a high price.

There is every reason to believe that the cultivation of the tea plant will be very widely spread in future years, and that the trade in tea produced in India will become considerable in extent.

81. An Agricultural and Horticultural Society having been established in the Punjab, the Government has given to it a liberal annual contribution, and constant support and aid.

Different kinds of seeds have been procured from Europe for the improvement of agriculture in that Province.

The growth of Flax has been largely encouraged, and the cultivation of it at once extended to very considerable dimensions.

An experiment for the growth of Silk having been undertaken, workmen skilled in the business, mulberry plants, and every other requisite were provided abundantly by the Government.

Measures have also been taken for preserving the breed of horses which was formerly much prized in the Punjab.

And, to aid the exertions of the Society for introducing a better breed of sheep into the country, Merino rams were procured by the Government, and application was made for the importation of a further supply from the Australian Colonies.

An experiment has been made of the practicability of introducing a breed of sheep into Pegu. The practicability had always previously been denied ; but the success which has already attended the establishment of large flocks in Upper Pegu gives the strongest reason to believe that the animal will speedily be naturalised in those districts, and multiply. The Natives show a strong desire to possess them. They thrive perfectly, and are singularly fruitful.

The object is one of great importance ; for the absence of sheep leads to a privation in respect of food, which is severely felt not only by the European Soldiers in the Province, but also by all of every class who are employed therein.

Corresponding measures for the encouragement of agriculture have not been wanting in the elder Provinces ; and a large pecuniary grant was recently sanctioned by the Supreme Government, on the application of the Government of Madras, for the establishment of periodical Agricultural Shows within that Presidency.

82. The preservation and renewal of Forests in different parts of India is an object of the highest public importance, which until lately had not received the attention it deserved. Rules have now been laid down, and appointments have been made, which it is hoped will for the future have the effect of preventing all unthrifty management of the forests, on which we must mainly depend for the supply of necessary timber ; while the renewal of the trees, as well as their preservation, will be provided for.

With that view a Conservator of Forests was appointed in Pegu, as soon as we obtained possession of the Province.

A similar Officer has been appointed for Tenasserim and Martaban.

The principal forests from which our supply of timber for public purposes in Hindostan was derived belonged to the Government of Oude. They have heretofore been beyond our control, but they will now be carefully regulated and preserved.

A transit duty was until lately levied on the export of timber grown on grants of land made to private persons in the Deyrah Dhoon. This transit duty has been relinquished. But for the proper conservancy of forests in the Dhoon, it has been deemed necessary to prevent the felling of timber without the sanction of a Superintendent of Forests, who is appointed by the Government to ensure due precaution being taken against the waste and injury to the forests which had hitherto gone on unchecked.

Similar endeavours have been made for the preservation of the forests within the Hill States. But as most of these belong to Hill Chiefs, the attainment of the object at which the Government aims is beset with difficulties.

Regulations, however, have been laid down for the management and for the renewal of those forests over which the Government can exercise control.

A complete examination of all the forests upon the Sutlej and Beas has been made by an Officer appointed by the Government of India, and every precaution has been taken for their future preservation and thrifty management, by leasing tracts of forests for our own use, by the prohibition of burning the hill sides, and by the exercise of such influence as can be used with the improvident and ignorant petty potentates to whom the forests for the most part belong.

Throughout the whole Punjab, the Government, as well as private persons, is almost wholly dependent for a supply of timber upon the forests

in Chumba and in the Territories of Maharaja Gholab Sing. To facilitate the supply, and to prevent extortion, a Government Agency has been established with wholesome effect.

The plains of the Punjab are wholly destitute of forest trees. Shortly after our occupation of the Province instructions were issued by the Government, with a view to the gradual removal of this great want. It is hoped that the measures which were enjoined, and which have been vigorously carried into effect, may in due time produce the results which the Government has had in view. But the process must needs be slow, and if success shall ultimately be attained, it must be the work of time.

83. During the last eight years, persevering efforts have been made to render available the mineral wealth which this country is believed to possess.

At the present time two principal necessities which press upon the Government, and are felt to be essential to the interests of the community, are Iron and Coal. Every possible effort has been made, and is still making, to supply those great necessities.

84. Immediately after the annexation of the Punjab, an examination of the Salt Range was made, with a view to determine the extent of the Coal within it, of which seams had been found at Kalabagh.

The result of the examination unfortunately established that the coal discovered at Kalabagh was a mere lignite, inconsiderable in quantity, and almost worthless in quality; and that the Salt Range contained no beds of real coal.

More recently the hopes of the Government were raised by the announcement of the discovery of coal in Pegu. But here also the seam unfortunately proved to be of inconsiderable extent. There is, however, good reason to hope that workable seams of coal may yet be found in Pegu, where, as well as in the Tenasserim Provinces, the mineral has been discovered at various points.

Mr. Oldham, a gentleman possessing scientific and practical knowledge of the subject, was appointed by the Court of Directors to make full examination of the Districts in which Coal might be present. Mr. Oldham has already examined the principal Districts of Bengal, Sylhet, and Tenasserim, and he is now carrying on his investigations in the Nerbudda Valley.

There is no doubt of the existence in India of coal in abundance; but the great difficulty of access to it, and distance, are formidable

impediments in the way of rendering it available for the purposes for which it is required.

85. Enquiries regarding the capacity of the Indian Territories as an iron-producing country were actively set on foot by the deputation of M. Marcadieu, in 1853, as a Geological Surveyor, to examine and report upon the iron mines which were said to exist in the hills to the North of Simla.

Reports were submitted by him on mines at various points. They proved the existence of rich iron ores at certain points ; but, from the situation of the mines, and the general scarcity of fuel and of water in the neighbourhood of them, it did not seem to the Court of Directors that the minerals in the Simla Hills held out sufficient inducement to the Government to undertake the working of them.

M. Marcadieu was also employed to enquire into and report upon the supply of Borax, which was said to be found in the Inner Himalayas. The enquiry was urgently pressed by the English manufacturers of porcelain and pottery.

The Borax exists in great abundance in a very wild and remote country belonging to Maharaja Gholab Sing, beyond Spiti and Kooloo. The difficulties of access are very great. The Maharaja has given assurance that he will not raise his duty on the article. The Government of India has promised its best aid. But the Chamber of Commerce in the potteries seems now disinclined to pursue the trade in Borax at so remote a point.

The Hon'ble Court deputed Mr. Henwood, a gentleman possessing practical experience as well as scientific knowledge of the subject, to survey the Districts of Kumaon and Gurhwal, where iron deposits were said to abound.

During the last year the researches of Colonel Drummond and those of Mr. Henwood appeared to the Government of India to have established the practicability and the expediency of commencing mining operations in the Districts above-mentioned. Accordingly an experimental mining and smelting establishment at the foot of the Kumaon Hills has been sanctioned by the Government ; and it is already in progress under the direct control of the Lieutenant-Governor of the North-Western Provinces.

Other investigations carried on simultaneously by different persons in various quarters, have been equally successful in the discovery of iron ores.

In the Nerbudda Valley, the existence of rich mines of iron have been ascertained by local examinations, conducted by the surveyors of the Bombay, Baroda and Central India Railway Company, under the direction of Colonel Kennedy ; and proposals for working the mineral at Ponassa have, some time since, been laid before the Hon'ble Court.

Iron has been found, and has been actually manufactured, very recently, in districts near Beerbhoom.

Lastly, proposals have during the last few weeks been submitted to the Government of India by Mr. Hunt, one of the Contractors on the East Indian Railway, for leasing and working mines of iron and coal which he has succeeded in finding in the districts not far from Jubbul-pore.

On these encouraging facts, fair hopes may be built, that the present most urgent want of India in connection with her material improvement, namely, an ample supply of good iron within her own bounds, may at no distant date be abundantly supplied.

86. Before proceeding to describe the various classes of Public Works, which during the last eight years have been undertaken by the Government for the material improvement of the country, it should be stated that steps have been taken for the execution of a Topographical Survey of all our recent territorial acquisitions, as a measure which is a necessary preliminary to all systematic improvement.

Thus in the Punjab, surveys were very early established, in different portions of the Province, and on a large scale.

The Northern boundary of Pegu has been very accurately laid down by Major Allan. It was a work of great difficulty and delicacy, and has been executed with much ability and with complete success.

A topographical survey of Pegu is already in progress, and a similar measure has been directed in the adjoining Province of Martaban.

Measures have also been taken for obtaining, as soon as may be practicable, topographical surveys of Nagpore and Sindé, as well as of the Assigned Districts of Hyderabad.

In connection with this part of the subject, it may be mentioned, that in Central India, the consent of all the Native States has been obtained to the making of a topographical survey, and to a demarcation of all the boundaries between the several Native States, and between the British Territories and those of Native States.

This measure is of great importance and value, not only with reference to the possible future improvement of those Territories, but for the preservation of public tranquillity, which has heretofore been so frequently disturbed by feuds arising from disputed boundaries.

87. Of all the works of public improvement which can be applied to an Indian Province, works of Irrigation are the happiest in their effects upon the physical condition of the people. And foremost among all the works of irrigation that the world, as yet, has ever seen, stands the Ganges Canal, whose main stream was for the first time opened on the 8th April 1854.

When the opening of the Canal was reported to the Hon'ble Court, the work was thus briefly described :—

“ Within eight years the main lines of the Ganges Canal, applicable  
Minute Governor General; dated 5th May 1854. to the double purpose of irrigation and navigation, have been designed, executed, and opened.

“ Extending over 525 miles in length, measuring in its greatest depth ten feet, and in its extreme breadth 170 feet, the main irrigation line of the Ganges Canal is justly described, ‘as a work which stands unequalled in its class and character among the efforts of civilized nations.’—(Letter of Lieutenant Governor, April 1854, *para.* 8.)

“ Its length is five-fold greater than that of all the main lines of Lombardy united, and more than twice the length of the aggregate irrigation lines of Lombardy and Egypt together—the only countries in the world whose works of irrigation rise above insignificance.

“ As a single work of navigation for purposes of commerce, the Ganges Canal has no competitor throughout the world. No single Canal in Europe has attained to half the magnitude of this Indian work. It nearly equals the aggregate length of the four greatest Canals in France; it greatly exceeds all the first class Canals of Holland put together, and it is greater, by nearly one-third, than the greatest Navigation Canal in the United States of America.

“ I have spoken here of the main line alone. When the branches in progress shall have been completed, the extent and influence of the work will be vastly increased throughout all its gigantic proportions.

“ Wonderful and admirable in all respects as the Ganges Canal is felt to be, it has been well said, in the words which the Lieutenant-Governor

“has quoted, ‘that there is no more striking fact in connexion with it than that such a truly gigantic undertaking should have been, in its designs, the work of a single intellect, and, in its execution, the work of “a third part of one man’s professional life.”’ ”

All the plans for the prosecution of the works upon the Canal had been formed before the Government of India was placed in my hands. But of the sum of £1,400,000 which had been expended upon the Canal at the time of its opening in 1854, all excepting £170,000 has been granted since my administration commenced. No financial pressure—no exigencies of war—were suffered to interrupt the progress of that great work. Its main lines have now been opened for nearly two years. The water has been admitted over their whole length. The works have stood the test, during the last monsoon, of some of the severest floods that have ever been known ; and as yet the success has been, in all respects, complete.

When the branches shall be finished, the Canal will extend to about 900 miles in length. It is estimated that the area which may be irrigated by its waters will not be less than 1,470,000 acres. But none can estimate, in their full extent, the blessings which its fertilizing influence will confer upon millions, whom it will place henceforth beyond the reach of those periodical calamities of season, which from time to time, as in 1837, have brought upon the plains of Hindostan the wide spread desolation of famine and death.

I trust I shall not be thought vain-glorious if I say, that the successful execution and completion of such a work as the Ganges Canal would, even if it stood alone, suffice to signalise an Indian administration.

I rejoice to know that the gracious favor of the Sovereign was promptly shown to the man, whose genius designed, and whose energy so rapidly completed, this noble work ; and that Sir Proby Cautley has been worthily decorated with high honors from the Crown.

SS. Although the gigantic proportions of the Ganges Canal might appear at first sight to dwarf all other similar works into insignificance, the Government during these years has undertaken other irrigation projects, which must also be regarded as of great magnitude and importance

Soon after the annexation of the Punjab the sanction of the Government was given to the construction of a large Canal with various branches, which should be fed by the waters of the River Ravee, and which should be applied to the irrigation of the Manjha, (the tract



which was chiefly inhabited by the Seikhs,) and of the rest of the Baree Doab.

The work has been carried on with vigour and success. The main line with its branches will extend over not less than 465 miles. Its stream will be at its head 120 feet in breadth, and  $5\frac{1}{2}$  feet in depth, diminishing at its lower end to 16 feet in breadth and  $2\frac{1}{2}$  feet in depth. Its course is intended to be navigable ; and even during the dry season of the year the Canal head will roll down a body of water amounting to not less than 3,000 cubic feet in each second.

The Report on the Punjab did not exaggerate the magnitude or the importance of the works in the Baree Doab, when  
Second Punjab Report; para. 424. it stated that the new canal would be "second in India only to the great Ganges Canal, and equal, if not superior, to "the finest irrigation canals in Europe."

89. In the Mooltan District we found a vast number of smaller canals, fed by the periodical inundations from the rivers of the Punjab. They had been originally dug by the Pathan Governors, and had more recently been repaired by Sawun Mull, the father of Dewan Moolraj.

An Officer was appointed to supervise the clearance of the canals and the distribution of the waters. "The canals,"  
Second Punjab Report; para. 429. it is stated, "have been both enlarged and improved ; and as regards conservancy and subsidiary management they "are in more efficient order than ever they were, even in the palmy days "of Sawun Mull."

The aggregate length of the inundation Canals in the District of Mooltan is upwards of 600 miles.

90. The Inundation Canals in the Derajat are of local importance ; but the streams are troublesome, and the people have not been successful in their management of them.

A survey of all these canals was made, and the improvement of them is still in progress.

In the Cis-Sutlej Province, where surveys for great irrigation works were completed several years ago, no commencement has yet been made, or could have been made, while the expensive works already mentioned more urgently demanded the attention of the Government.

Some amendment, however, has been wrought in those arid regions by a proper distribution of the waters of the Gugger and Sursotee Rivers, which was effected some years ago by the exercise of the

influence of the Government among the Chiefs of the Seikh protected States.

92. Even the Lower Provinces of the Bengal Presidency, where the usual abundance of the annual rains diminishes the necessity and the call for works of irrigation, have received their due share of improvement under this head ; a comprehensive project for the irrigation of the Districts of Shahabad and Behar, by a canal from the River Soane, and by large reservoirs which are to be formed by ' bunding' up the streams where they issue from the hills, has been strongly recommended to the Hon'ble Court.

93. Among many works which have been constructed in the Presidency of Madras during these years, for the supply of tanks and for other modes of irrigation, I think it necessary to enumerate only a few.

A magnificent work has been designed and executed by Colonel Cotton and his successors, in the construction of the great Anicut across the River Godavery, whereby the means of irrigation will be given to very large tracts of country, to which such security against the constant risk of famine will be beyond all value.

94. For similar purposes of irrigation, sanction was given to the construction of a Regulating Dam across the rivers Cauvery and Venaar.

In order to render the water of the Kistna available for purposes of irrigation, the formation of a great Anicut across that river has been sanctioned.

A similar Anicut was sanctioned on the river Pennair, which, while it answered the purposes of a bridge, has secured and extended the cultivation of a large tract of Country besides.

When the Anicut across the River Palar shall be finished, it will ensure a supply of water to the tanks on both sides of the river in the Districts of North Arcot and Chingleput, and will confer substantial benefit on the whole country within its scope.

95. In the Presidency of Bombay proposals have been made by a Joint Stock Company to undertake the execution of great works of irrigation throughout the various Districts of the Presidency, on terms which are set forth in its proposals. The project has been submitted to the Hon'ble Court by the Government of India, and acceptance of the proposals of the Company has been recommended, with certain large modifications which it is not necessary to specify.

96. In Sind the construction of a canal connecting the river Indus with the Narra Stream has been approved. By this work the channel

of the Narra will be annually and regularly supplied with water, which hitherto it has only received by extraordinary inundations once in twenty or twenty-five years.

The certain result will be immense benefit to the people of the Province, and consequent increase to its revenue.

In Lower Sind the channels of the Foolalie Canal have been cleared and improved ; and in Upper Sind similar and extensive measures of improvement have been executed on the channel of the Begarie Canal.

97. Next in order, to works of irrigation, stand works for improving the general communications of the country. Of these, works of internal navigation shall first be noticed.

98. Already, before 1848, the Ganges had been covered with a flotilla of river steamers, provided as well by Government as by the enterprise of private Companies, for conveying the great trade which sought passage upon its waters.

99. When the conquest of the Punjab gave the upper stream of the River Indus into our possession, the Government was in hopes that private enterprise would place river steamers upon its streams even more abundantly than upon the Ganges. That hope was disappointed. The Government therefore endeavoured, by its own flotilla, to establish a regular communication by steam between the sea and the rivers of the Punjab.

Accordingly, river steamers have for several years periodically made the passage from Kurrachee to Mooltan, and there seems no reason to doubt that if the steamers were more numerous, more certainly accessible to the public, and better adapted to the shallow waters on which they ply, their services would be of infinite benefit to the frontier trade.

In the mean time the channel of the Indus is becoming the great highway between Europe and the North-Western Provinces of our possessions. Troops arrive and depart from England by that route. Recruits are sent out and invalids are sent home each year by its stream, thus avoiding the long and weary march which must otherwise be made by Calcutta. Great quantities of heavy stores follow the same course. And passengers in large numbers now by preference seek by it a point of departure at Bombay.

A proposal has been made by the Government of Bombay for despatching two steamers on experimental trips from Kurrachee direct to

Suez. The result of it, should it prove successful, will add importance and value to steam communication upon the Indus.

100. Surveys have been made of the principal rivers of the Punjab, with a view to the extension of river navigation still further into the interior of the Province.

The Indus may certainly be navigated nearly as far as Kalabagh ; and, at no great expense, it might be made navigable to Attock.

Occasional trips have been made by steamers in the rains as far as the Military Depôt at Jhelum ; and although the results of the surveys of the other streams cannot be said to be encouraging, there is no doubt that internal navigation may be extended much further within the Punjab than has yet been attempted.

101. Immediately after the occupation of the Province of Pegu, half of the steam flotilla upon the Ganges was transferred to the Irrawaddy, and it forms now the great vehicle for trade, and for the conveyance of supplies between the Frontier and the sea.

This Province is peculiarly adapted for the services of river steamers, and it is to be hoped that the flotilla will be largely increased.

Already a project has been laid before the Hon'ble Court for removing the obstacles which impede a free navigation between the Bassein River and the Irrawaddy.

Surveys have been made in the hopes of finding the means of opening a similarly free channel between the Pegu River and the River Sitang.

During last year, there was discovered an excellent channel through the creeks, which gives a passage, perfectly safe and open at all times, between Bassein and Rangoon.

A creek already exists between the River Sitang and the River Salween, in the neighbourhood of Beling, which, it is stated, might at small expense be made navigable throughout the year.

If, therefore, the channel which has been surveyed between the Sitang and the Pegu Rivers should be formed, a continuous line of internal navigation, open at all seasons of the year, will be available for river steamers throughout the whole breadth of the Eastern Provinces, from the port at the mouth of the Bassein River to the anchorage at Moulmein.

102. The necessity for the employment of regular means of communication throughout the Province of Assam upon the stream of the River Burrumpootra, has long been increasingly felt. It has lately been resolved to place upon that river such portion of the Government

flotilla upon the Ganges as can from time to time be spared from more urgent duties, and application has been made to the Hon'ble Court for additional steamers to be employed upon the Burrumpootra.

103. Examination has been made of the stream of the River Nerbudda.

The Report which has been published of the result of the examination affords little hope that the Nerbudda will ever be rendered a navigable river for purposes of trade.

104. A survey of the River Godavery, upon the opposite coast, has given a result of much more hopeful aspect.

Although I do not concur with those who hold that, if the streams of the Godavery and of its tributary the Wyngunga should be made navigable at all seasons, the cotton trade of Berar and Nagpore would be transported by this channel to the Sea, notwithstanding the construction of a Railway between those Districts and Bombay, yet I am fully alive to the importance of opening this great inland navigation, if it be possible, for general purposes of communication and trade. The Government of India, therefore, has given full sanction to the prosecution, with proper caution, of the extensive operations which the nature of the river channel, so far as it is yet known, seems to render indispensable, before the Godavery can be made a navigable stream.

105. Besides the measures which have been taken in regard to navigable rivers, the means of internal navigation have been considerably increased during the last eight years by the completion of various navigation canals.

The works of the great Ganges Canal and of the Baree Doab Canals, both of which will be available for navigation, have already been noticed.

In the Madras Presidency considerable improvements and extensions have been made in the channel of Cochrane's Canal.

A canal has been constructed to connect the Ports of Porto Novo and Cuddalore, in the District of South Arcot.

In connexion with this work, sanction has been given to the construction of a canal along the Eastern Coast between the Rivers Adyar and Palar. The general importance of this work to the country is very great. It is capable of being prolonged from Palar to Cuddalore, where it would join the new canal from Porto Novo, which again is connected with the line of water communication between Coimbatore and the sea-coast through the Province of Tanjore. Thus a long line of inland navi-

gation would ultimately be established with great benefit to the country.

In the budget of the year 1855-56, further proposals were made for extending the several lines of internal navigation at an expense of not less than 15 lakhs of Rupees; and they have been recommended for the approval of the Hon'ble Court.

106. The value of all such channels of inland navigation as lead to the sea must of course be greatly dependent upon the condition of the ports at which they respectively terminate. The public records will show that the improvement of ports of shipment has not been lost sight of.

107. The access to the Port of Calcutta, for a great part of the immense trade which flows to it from Bengal and other Provinces, lay through the Soonderbunds, which were connected with the Hooghly by two canals.

These have been enlarged and deepened.

The accommodation in the Port of Calcutta for the increasing number of ships which of late years have resorted to it has been considerably augmented.

108. Some alarm having been generally felt that the navigation of the Hooghly was gradually and yearly deteriorating, and that there was some risk of the loss of the Port of Calcutta by the silting up of the channels, an enquiry was directed to be made.

It was conducted with great deliberation and care, and the Report is now before the Government.

In order to meet the wishes of those who desired that precautions should be taken to meet the evil which they believed to be approaching, renewed examination was made of the River Mutlah, a channel in the Soonderbunds lying to the Eastward, and navigable for the largest ships to within twenty-five miles of Calcutta.

The result of the examination was satisfactory.

An experiment has lately been tried of lading a ship in the Mutlah. The stream has been buoyed by the Government, the advice of the Government Officers has been given, and every other assistance has been afforded to those who have been turning their attention to the new channel.

It may be added, that before any steps were taken which could draw attention to the possible future importance of the Mutlah, I took the precaution of purchasing on behalf of Government, and for an inconsiderable sum, the large estate which occupied the site where the new

port must be placed, if the trade should be diverted to the Mutlah Channel.

As a further measure of improvement for the Port of Calcutta a project has been entertained for throwing a bridge across the River Hooghly. Boring operations have already been commenced ; and the subject, in all its parts, is now under consideration.

109. The accommodation of the Harbour of Bombay has been improved by the addition and extension of piers, and by the recovery of Moodee Bay at a large expense from the sea ; whereby ground for a Railway Terminus, a Custom House, Basin, &c., will be obtained and much additional space will be secured.

The works which have been sanctioned for bringing a supply of water into the Island of Bombay may properly be included among the improvements of its Port. A lake is to be formed at Vehar, on the Island of Salsette, by 'bundling' up the stream which flows from the hills in that vicinity.

For this great work the Government has consented to advance 25 lakhs of Rupees, secured by an increase of the house assessment in the Island of Bombay.

110. The Harbour of Kurrachee has also been much improved. Until of late, the Harbour was supposed to be inaccessible during the monsoon. Its accessibility at that season has now been fully proved ; and communication with Bombay and all other quarters will continue uninterrupted throughout the year.

111. Measures have been recommended for the improvement of the Harbours of Coringa and Coconada.

112. Complaints having frequently been made of the unprotected state of the Harbour at Singapore, heavy batteries have been constructed, to an extent which the Military Engineers have considered to be amply sufficient for the ordinary defence of the port.

113. Lights, Buoys, and Pilots have been provided for the Port of Rangoon, and provision is now being made for the new Port of Dalhousie on the Bassein River.

114. As a measure of the utmost importance to the trade with these Ports, and with Moulméin, the construction of a Lighthouse upon the Alguada Reef, to the Southward of Cape Negrais, has been strongly recommended to the Hon'ble Court.

The ports of the Indian Territories are comparatively few in number, and for the most part, of little natural value.

The statement now given will show that the Government of India during these years has, at least, endeavoured to turn them to the best account.

115. I have only to add that a new Code of Rules for the regulation and conservancy of Indian Ports has lately been passed into law. It was much required, and will be of great value to the interests of navigation and trade.

116. It remains for me to advert to those works of improvement by which the land communications of the country have during the last eight years been opened up and amended.

117. The introduction into India of the greatest improvement which man's invention has yet applied to the means of movement and carriage by land, namely, the Locomotive Engine upon iron rails, has already been fully narrated.

118. It would be impossible to compress within the limits I wish to observe an enumeration of all the works which have been executed or sanctioned by the Government of India for the improvement of inland communication, by means of ordinary roads, during the past eight years. I shall notice merely a few of the leading lines.

119. The Grand Trunk Road, which had, speaking generally, been completed as far as Delhi, has been carried on without interruption.

In the Lower Provinces many large bridges have been constructed; but it must unfortunately be added that several have been destroyed by the force of floods; and their place must again be supplied.

Until a bridge shall be built across the River Soane, a formidable work, whose accomplishment must still be regarded as remote, the passage of the river will present vexatious difficulties and cause excessive delays. To obviate these, as far as may be possible, the Government is engaged in laying down a Causeway of stone across the river bed. This work, though but a temporary expedient, will be productive in the mean time of great public benefit.

Without imputing blame in any quarter, it must be observed that during these years the progress that has been made in the Trunk Road between Delhi and the Sutlej appears to have been slow. The difficulties, however, have been great, and the road is now approaching to completion.



120. When the Punjab became a British Province, the prolongation of the Grand Trunk Road across its breadth was seen to be an object of primary importance. Accordingly the line has been carried from Loodiana by Jullundur to the Beas, and thence by Umritsur to Lahore, and from Lahore by Wuzeerabad, Jhelum, Rawul Pindee, and Attock, to Peshawur.

Every natural difficulty that can be conceived has been encountered ; vast expense has been incurred ; but the road is rapidly approaching to completion, and by its usefulness will repay a thousand-fold the labor and the treasure it has cost.

121. Sanction has been given to the construction of a road from Patna by Gya to join the line of the Grand Trunk Road. This is perhaps the most important cross-road in the Lower Provinces, and the traffic upon the line of country is said to be exceedingly great. The present line will form an essential branch of the Grand Trunk Road, and when the Railway shall have been constructed on the Patna and Mirzapore line, the road will become of still greater importance as a feeder to the Railway.

122. A road, available at all seasons of the year, has been formed from Cuttack to Ungool and Sumbulpore, and has usefully opened up that wild tract of country.

123. A line of the utmost importance has been constructed from Dacca to Akyab.

An improved communication with the Province of Arracan had long been much required ; but when political necessity compelled the Government to take possession of Pegu, it became an object of vital importance to the Government to be able to command the means of communicating with Pegu by land, so that it might have the power at all times of despatching troops from Bengal to Pegu, for reinforcement or in relief, without being obstructed by the sepoys' conditions of enlistment, which entitled him to refuse to proceed on service by sea.

The work has been very costly, and attended with serious difficulty, from the pestilential climate of much of the country through which it passes.

Iron ferry-boats have been provided to facilitate the passage of troops across the rivers which lie in the way.

From Akyab to a point behind the Island of Ramree, the troops will be conveyed by an inland creek navigation, which has been carefully examined and arranged. From this point the troops will cross the Toun-

ghoop Pass into Pegu by a road, which will be particularly noticed hereafter.

124. A project for a road from Calcutta to Dacca, there to join the Dacca and Akyab Road which has just been described, was called for; but the natural difficulties between Jessore and Dacca appeared, for the present at least, to be insuperable.

125. With respect to district roads the Government of India has consented that the ferry funds of the Lower Provinces and the tolls levied on the Nuddea Rivers and on the Calcutta Canals, amounting in all to about five lakhs a year, should be thrown together as a fund for the construction and maintenance of district roads.

The distribution of the funds will be made by the Local Government, on the principle that no district road shall be formed from the fund until due provision shall have been made for its maintenance by means of local resources.

126. In the Province of the Punjab, besides the great Trunk Road from Lahore to Peshawur, to which reference has already been made, a vast extent of road has been constructed during the last seven years, for every different purpose, Military, Commercial, and Local. To enumerate them would be tedious. A full description of them will be found in the First and Second Punjab Reports, and more especially in the Punjab Road Report, all of which have been printed.

127. In Pegu the difficulties which impede the formation of roads are similar to those which render the construction of them in a permanent form almost impossible in Bengal.

Excepting the road from Prome to Meeaday, no continuous line has yet been executed in the new Province; but Surveys have been executed for three great lines of road,

1st,—From Rangoon to Prome;

2nd,—From Rangoon by Pegu to Tounghoo;

3rd,—From Martaban by Sitang and Shoeygheen to Tounghoo.

The impediments to be overcome on all these lines are very serious: the cost will be excessive. Nevertheless, it is to be hoped, that they will be undertaken with vigor and prosecuted to a successful conclusion. Their effect will be incalculably great.

128. In the new Provinces of Nagpore and Hyderabad, the impossibility of providing a full establishment of Engineers at present has prevented any general plan of public works being formed.

129. In Sinde a complete system of roads from Kurrachee to the Northern boundary was proposed by the Commissioner. They will be executed gradually, but as speedily as the necessary agency for their construction can be found.

130. The principal systems of roads which have been projected within our new Provinces, and some other leading works, have now been enumerated. I abstain from mentioning in detail the roads which have been sanctioned in the Presidencies of Madras and Bombay; for, although the returns before me show that those roads are exceedingly numerous, and that in the aggregate their cost amounts to an enormous sum, the aggregate is made up of so many single items, which though of great local importance, are of little general interest, that the recital of them would be tedious, and of no obvious profit for any purpose.

131. Two important works have been reserved for separate notice, by reason of the peculiarity of their situation and of the circumstances under which they have been carried on with singular success—I refer to the mountain roads in the Himalaya and in the Gomah Range of Arracan.

The Hindostan and Thibet Road, when it shall have been completed, will (as its name imports) connect the Plains of Hindostan with the Frontier of Thibet. A full and most interesting Report upon this road has been prepared by Lieutenant Briggs, the Officer who has borne the chief part in constructing it. The Report will shortly be published. All description of the road in this paper shall, therefore, be confined to the merest outline.

The work had its origin in the desire entertained by the Government to abolish and to remove all pretext for defending Begaree (or the system of employing the forced labor of coolies) in the Hills. So far as the Government was concerned, that system had the sanction of treaties; for every Chief was bound, whenever he should be called upon, to find upon his own part bands of laborers for the temporary service of the State.

The Government has always remunerated amply the coolies who were so employed for the time they served; but the money was usually in great measure taken from them by their own Chiefs on their return. They were forced to travel great distances, and in many ways they suffered oppression from the duty.

The abuse of the system by private individuals was believed to be great, though every endeavour upon the part of the Government was steadily made to check it.

Yet the evil of the system itself was unavoidable by any means. So long as the Hill roads, even to the English Settlements and military stations, continued to be little better than mountain paths, no other labor than that of men could transport whatever was to be carried, and no substitute for Begaree could be found. The first step, therefore, and the only step necessary for the abolition of Begaree, was to construct a system of roads which would admit of all articles being carried upon beasts of burden, or even dragged in wheeled conveyances of various kinds.

For the furtherance of this purpose a road, first designed by Major Kennedy, and executed by Lieutenant Briggs, has been constructed from the plains at Kalka to the Hill station of Simla. It is about fifty miles in length. It is already sixteen feet in breadth, and has nowhere a steeper gradient than three feet in the hundred, constituting a hardly perceptible rise.

From this road, branches have been carried to the military stations at Kussowlee and Subathoo, and a branch is now being formed to connect those stations with the Plains towards the Sutlej.

Before long the distance from Simla to Kalka will be considerably shortened by a tunnel which is now being formed, and wheeled carriages will be placed upon the road.

From Simla, the station most remote from the Plains, the road towards Thibet has been formed as yet on a smaller scale, and it is still incomplete.

In many portions of its length from Simla to the Valley of Chini, which is its present terminus, the road is finished to a breadth of six feet, and is generally used.

It is easy to conceive the obstacles which must be met and overcome, among the valleys and forests and cliffs of the mighty ranges of the Himalayas, for the right formation through the midst of them of a road which is everywhere to conform to the gradient already mentioned of three in every hundred feet; nor can rapid progress be expected; but the difficulties are yielding one by one. The greatest difficulty of all, namely scarcity of labor, admits of no remedy, for labor from the Plains is, for such a purpose, of little value in the Hills. Nevertheless a steady progress has been made.

Within a year, I trust that the completion of the road to Chini will enable the Government to try an experiment which I have long had

much at heart, but which, until the road should be completed, could not be carried into execution, I mean the establishment of a Convalescent Station for sick European soldiers in the Valley of Chini.

Medical testimony and personal experience combine to encourage the belief to which I strongly hold, that such an institution would be productive of sanitary benefits for the European soldiers of the Army in India, such as no hill station in the Himalayas has yet been found to give, and such as would indirectly produce essential advantage for the State.

When, too, the road shall be completed to Chini, and still more when it shall be carried as far as the Frontier of Thibet, it may be expected that the form of trade which now shows every article conveyed in a little pack upon the shoulders of a goat will disappear, and that the commerce with Thibet will assume, both in quantity and value, the considerable proportions which all who are well-informed upon the subject have anticipated for it.

Above all, I trust that whenever the completion of the road shall afford the means of traversing the Hills as readily as the Plains, Begaree, both for public and private purposes, will be abolished ; that recurrence to it under any pretext will be prohibited ; and that the treaty right of the Government will be reserved solely for times of war or for some such great occasion of public emergency as, I trust, may never arise.

Thus the construction of this Hill road will become a lasting blessing to the people of the Hills, as it is even already a lasting honor to the Government of the East India Company, by one of whose many able and energetic Officers it has been mainly carried into execution.

132. The construction of the Hill road over the Tounghoop Pass, from Arracan into Pegu, arose out of the necessity which occupation of the new Province had created for direct military communication, by land, with the Presidency of Bengal.

With great difficulty and labor 150 elephants had forced their way over the mountains and through the forest in 1852, to aid the operations of the Army at Prome. The natural obstacles were very great. The mountains were lofty, the forests dense, and the climate for a large portion of the year pestilential. There was little water to be found, and no labor was procurable except that of Burman villagers, disinclined to toil of any kind, and afraid to commit themselves to our service.

These difficulties seemed at first to make the formation, within a reasonable time, of a road across the Gomah Range almost a desperate hope. Nevertheless the vigor and perseverance and remarkable tact of Lieutenant Forlong, the Officer to whom the work was committed, overcame every obstacle with a speed which far outran our liveliest hopes.

The range was everywhere surveyed. A line of road was formed. Burmese laborers were collected; were trained to the peculiar work; were induced to submit to organization; and even roused to emulation, and effectual industry. It was not until the end of December 1853 that the work was fairly commenced. In the spring of 1855, the Arracan Battalion, with all its baggage and followers, marched over the road from Prome to the sea.

The road is now rapidly approaching to completion. In the Arracan Section, 20 miles are opened for carts to 15 feet of breadth, and 30 miles to a breadth of from 6 to 9 feet. In the Pegu Section, 21 miles in the Plains have been completed to a width of 24 feet, and 22 bridges have been built.

In the mountains on the Pegu side 20 miles have been opened for carts to a breadth of from 12 to 20 feet, and 24 miles from 6 to 10 feet.

Arrangements have been made for shelter and for water, and the 8th Regiment of Irregular Cavalry are just about to march over the road.

If due regard be had to the difficulties which stood in the way of such an undertaking, and which have already been adverted to, and if it be remembered that the working season in the Gomah Hills lasts only from December to April, if so long, and that consequently the working year is no more than five months in duration, the Hon'ble Court will feel that the construction of the Arracan Hill road by Lieutenant Forlong, under the circumstances, and with the speed and success that have been described, is an achievement which is highly honorable to himself and to the Service of the East India Company.

133. Lest, in my anxiety to avoid an enumeration of single works, which might prove tedious and uninteresting, I should create upon the minds of those who may read this Minute an impression that the attention and the revenue which have been devoted by the Supreme Government to the prosecution of public works in India of late years have been less in amount than has sometimes been supposed, I beg to recall to recol-

lection the aggregate sum which has yearly of late been expended on public works in India.

The charges on account of public works in the year 1853-54 rose to 252½ lakhs, or £2,525,000.

The charges on account of public works for the year 1854-55 rose still higher to 299¾ lakhs, or very nearly £3,000,000 Sterling.

Of this aggregate sum in each year a very large proportion was expended on *new* works.

The charge for extraordinary public works alone, in the year 1855-56, is estimated at 224¾ lakhs, or nearly £2,250,000 Sterling.

The simple statement of these figures affords the means to all of forming at once an estimate of the real extent to which the Government of India in recent years has carried the execution of public works, designed for the improvement of the Indian Territories.

134. While the Government of India has thus been earnest in its endeavors to urge the prosecution of new works of public advantage, it has not neglected to take due measures for the preservation of the magnificent works of former times.

The attention of the Government having been drawn to the fact, that the noble arches and other remains of ancient architecture in the immediate vicinity of the Kootub at Delhi were in such disrepair that there was danger of their falling in, and of their being thus lost to the world, immediate orders were given for their preservation.

At the same time general instructions were issued to the Officers of Government, declaring the desire of the Governor General in Council that all such interesting and instructive monuments of former people, and former days, should be carefully preserved, and that the executive Officers at Agra, Delhi, and wherever such remains are to be found, should consider it a part of their duty to see that they were upheld and sedulously cared for.

Similar orders had been issued in the Punjab, with especial reference to the buildings there, soon after our occupation of the Province.

It is hoped that these injunctions, and the care of the Civil Authorities, and of the departmental Officers at each spot where architectural monuments remain, will be effectual for their preservation to still distant times.

135. For the proper superintendence and control of operations so extensive, and so various as those which are required for the execution

of public works in India, it is manifest that an organization of the highest order must be requisite.

The system of management which existed in 1848, and continued for some years afterwards, was altogether ineffective. It gave dissatisfaction to all alike—to the Officers of the department, to the Government, and to the public. The same dissatisfaction was felt by the Hon'ble Court, who six years ago directed that a Commission should be appointed at each Presidency to enquire into the whole subject.

The Commission which was appointed in the Presidency of Bengal reported decidedly and unanimously against the system which had been pursued by the Military Board, and suggested the general outline of a scheme for the future management of the Department of Public Works.

The principal features of the scheme proposed were these :—

1st,—That the control of the Department should be taken from the Military Board, and should be vested in a Chief Engineer for each Local Government.

2nd.—That each Local Government should exercise control over public works, Civil and Military, within their respective jurisdictions, under certain prescribed limitations.

3rd.—That the Chief Engineers should be assisted, as at present, by Executive Engineers, and where the Province was of sufficient extent, by Superintending Engineers also.

4th.—That the Executive Officers should be relieved in respect to the departmental accounts by which they had been overwhelmed.

This system was ultimately adopted for the Presidency of Bengal and for its Local Governments.

It was subsequently introduced into the Presidency of Madras and the Presidency of Bombay, with such modifications of detail as were necessary to adapt it to the peculiarities of each Local Government.

The experience which has been had as yet gives every encouragement to believe that, as a whole, the system now adopted is calculated to fulfil the purposes for which it was framed.

136. Under the orders of the Hon'ble Court of Directors, each Local Government has been directed to prepare for the Government of India, at a fixed period in each year, a Statement showing the public works which it proposes to commence or to carry on during the year to which the Statement refers. This Statement, which has insensibly acquired the designation of Budget, is intended to show every class



of public works which is proposed, or in progress, in each local jurisdiction. Its object is to impart method to the prosecution of public works, and to enable the Supreme Government and the Hon'ble Court to acquire an accurate knowledge of the extent to which public works are being carried on in the different divisions of the Empire, to regulate the expense which is to be incurred, and to control the general management and progress of public works throughout the country.

The Budgets, received and decided upon by the Government of India, so far as its authority extends, are to be annually submitted to the Hon'ble Court.

137. With reference to the power of giving sanction to public works, without reference to the Hon'ble Court, it may be observed, that the authority of the Governor General in Council now extends to the sanction of any work whose cost will not exceed one lakh of Rupees, and that the authority of Governors and Lieutenant-Governors is extended to grants of 25,000 Rupees.

138. The Government of India having thus been required to exercise a direct and vigilant control over the execution of public works in India, it became absolutely necessary that it should have professional assistance to enable it fitly to perform that duty. Formerly it was wholly without any such aid ; latterly, and since the commencement of Railways, it had become the practice for the Government to refer the engineering questions of every sort which came before it to its Railway Consulting Engineer. This however was only a temporary expedient, hardly fair to the Consulting Engineer, and quite insufficient for the state of things which had now arisen.

Accordingly, a Secretary for the Department of Public Works, with two Assistants, has been appointed in connexion with the Government of India.

The Secretariat of Public Works has already become a charge of great labor, and of the utmost public importance.

139. It will be readily perceived, that when there has been so great an increase of public works of late years, there must have been by some means a great addition made to the agency by which those works were to be executed. This has been the case.

Military Officers have been withdrawn for this purpose from their regimental duties in the Artillery and in the Line in large and unprecedented numbers,

The expedient is advantageous to the present interests of the Officers, and it affords a material relief to the present necessities of the Government. But there seems good reason for apprehending, that it will, after a time, prove deeply injurious to the military efficiency of the Army. It is to be hoped, therefore, that the experiment will be treated on all hands as a temporary one.

Her Majesty's Government gave, some time since, their consent to a certain small proportion of the Officers of Royal Regiments in India being employed in the Department of Public Works.

Further, an augmentation has been granted by the Hon'ble Court to the Engineers' Corps in each of the three Presidencies.

Lastly, the Hon'ble Court has consented to the employment of Civil Engineers in the Indian Department, many of whom have been engaged in this country, while a considerable number have already arrived from England.

Still further recourse must be had to this source of supply, if (as I earnestly hope) the execution of public works of improvement in India is to be followed up by the Government in future years with steady perseverance and with unabated vigor.

140. Simultaneously with the great exertions which have been made during these years to obtain from every various quarter a present supply of Officers for the Public Works Department, active means have been taken to form what, it is hoped, will prove a fruitful source of supply hereafter.

141. It was the far-seeing sagacity of Mr. Thomason which first anticipated the necessity of training Engineers in the country itself in which they were to be employed, and which first suggested an effectual method of doing so. On his recommendation, the Civil Engineering College at Roorkee, which now rightly bears his honored name, was founded with the consent of the Hon'ble Court. It has already been enlarged and extended greatly beyond its original limits.

Instruction is given in it to Soldiers preparing for subordinate employment in the Public Works Department, to young gentlemen not in the Service of Government, and to Natives upon certain conditions.

A higher class for Commissioned Officers of the Army was created some years ago, at the suggestion of the late Sir Charles Napier, and the Government has been most ready to consent to Officers obtaining leave to study there, as in the Senior Department at Sandhurst.

Excellent fruit has already been borne by this Institution. Many good public servants have already been sent forth into the Department, and applications for the services of students of the Thomason College were before long received from other Local Governments.

142. A similar College for Civil Engineering has lately been formed at Calcutta; another is in progress of formation at Madras; and a third has been sanctioned in the Presidency of Bombay.

143. Subsidiary to the Colleges there has been temporarily sanctioned a Civil Engineering Class at Lahore, and very recently a Civil Engineering Class at Poona.

144. In all these Institutions the object will be to provide instruction which shall supply its due training to every separate class required for the service of the Government in its Department of Public Works.

Hitherto, comparatively little has been done in India towards creating within itself the engineering skill which is now becoming one of its most urgent wants. But with such aids in prospect as those which have just been described, we may now look hopefully to the future.

145. Having thus concluded a recital of the measures which have been taken of late years for the prosecution of material improvements in India, it will not be out of place to make mention here of the progress that has been made during those same years towards the removal of certain noted evils, which have long been just causes of national reproach, and which have been viewed with considerable interest even by the community in England. The noted evils to which I refer are Suttee, Thuggee, Female Infanticide, and the Meriah Sacrifice.

146. The prohibition of Suttee by the British Government is now a familiar tale. In the time of those who preceded me great progress had been made in persuading all Native Princes to unite in denouncing the rite, and in punishing those who should disregard the prohibition.

The Government of India, since 1848, has had only to follow up the measures of preceding years.

When Suttee has occurred in any independent State, no opportunity of remonstrating has been lost; when it has occurred in any District which was within our control, no indulgence has been shown to the culprits.

Thus, renewed remonstrances have been addressed to Ulwar, Bheekaneer and Oodeypore.

But in Doongurpore, a petty State under our direct management, where the Thakoor's son took part in a Suttee, the son and two Brahmins who abetted his crime were condemned to imprisonment for three years in irons; while the Thakoor himself, for the same three years, was mulcted in half the revenue of his possessions.

The performance of the rite of Suttee is now a rare occurrence, either in Mahometan or Native States.

147. Thuggee has become almost unknown in the Provinces of India which lie to the Eastward of the Sutlej. The detective establishments of the Government are still maintained; but the brotherhood has disappeared; and the crime of Thuggee, in the peculiar sense in which the word is familiarly understood, can hardly now be said to exist.

The Provinces beyond the Sutlej are excepted in the preceding paragraph, because it appeared towards the close of 1851 that Thuggee, which it was previously supposed had never passed to the Westward of the Sutlej, had obtained a footing in the Punjab. The Board of Administration, however, were able to state in 1852, that  
 First Report; para. 187. "the Punjabee Thugs are not so dangerous as their brethren of Hindostan. The origin of the crime is comparatively of recent date. These Thugs have none of the subtle sagacity, the insidious perseverance, the religious faith, the dark superstition, the sacred ceremonies, the peculiar dialect, the mysterious bond of union, which so terribly distinguish the Indian Thugs. They are merely an organized body of highwaymen, and murderers, rude, ferocious, and desperate. They nearly all belong to one class of Sikhs, and that the lowest."

In 1854, the Chief Commissioner of the Punjab was able to report to the Government regarding Thuggee, that "during 1852, the last year in which the crime had any chance of making head, there were only thirty-five murders. Since that year the crime would appear to be almost extinct. During 1853 there was only one murder reported."

Wherefore, even in its last refuge, the Provinces across the Sutlej, while they were still under the dominion of the Sikhs, the crime of Thuggee can hardly now be said to exist.

In truth the only aspect in which Thugs can now be seen in India is in that of a well-conducted community at Jubbulpore, where the former approvers of the tribe, together with their relatives and their descendants, are kept under inspection; and where they form a quiet

and prosperous colony, remarkable only for the industry which they exhibit, and for the excellence of the fabrics produced by their hands,—fabrics which have taken their place in the great Exhibitions of London and of Paris, and which are said to have done no discredit there to the manufacturing skill of Indian nations.

148. The existence of the practice of Female Infanticide among the Rajpoots and other tribes of India has long been well known. The British Government has long striven against it, and denounced the cruelty of those by whom it was countenanced.

A great success regarding it was achieved, some years since, within the Provinces of Hindostan, by the energy and influence of Mr. Charles Raikes; and large numbers of Native tribes and families were then induced to set their faces against it. But the greatest triumph which has yet been accomplished has been within the Punjab.

Enquiry had shown that the Rajpoots, the Beders, (or descendants of Nanuck,) the Khutrees of the Sinde Doabs, and even the Suddozye Pathans, the Mahomedan tribes of Mooltan, and the wandering pastoral races in the central wastes of the Punjab, were all, more or less, addicted to this inhuman custom. The causes which led to it were found to be

Second Punjab Report; two-fold,—“ pride of birth and pride of purse; that  
para. 171. “ is, parents murder their infant daughters, either

“ because they cannot afford the marriage expenditure which must one  
“ day be incurred on their account, or because they foresee difficulties in  
“ marrying them suitably.”

Great exertions were made by all the Officers in the Punjab, among whom Mr. Raikes was now included.

On their recommendation the Governor General in Council authorized the convening of a great Meeting of the representatives of all the tribes at Umritsur in 1853.

The Meeting was held; and the assembled delegates united cordially in the adoption and promulgation of certain rules, their observance of which would effectually secure that no man should feel any real difficulty in providing for his daughter in marriage, and should consequently have no motive for the commission of Infanticide.

These Rules were adopted in the other Districts of the Punjab; and Maharaja Gholab Sing, in like manner, voluntarily and in public Durbar, adopted the Rules for the great Rajpoot clan within his Dominions.

“ If,” as the Chief Commissioner has remarked, “ future success  
 Second Punjab Report; “ should crown these initiatory measures, then, in  
 para. 177. “ some respects, a social revolution will have been  
 “ effected. Not only will a barbarous and secret crime have ceased, but  
 “ endless abuses connected with betrothal will be repressed, domestic  
 “ morality improved, and the female position secured.”

149. It only remains to notice the measures that have been taken for the suppression of Meriah Sacrifice.

This horrible rite, which consisted in the sacrifice with every circumstance of atrocity of young human victims, for the propitiation of the special divinity which presided over the fertility of the earth, prevails only among the Hill and jungle tribes of the Province of Orissa. Measures for the suppression of the rite had been undertaken before the year 1848. They had been steadily pursued in subsequent years. The nature of the country, the nature of the climate, the nature of the people, all was adverse to success, nevertheless the exertions of the Officers to whom the duty was entrusted have been singularly successful. Multitudes of victims during that time have been rescued from the horrible fate that awaited them, and have been settled in villages within our control. The various tribes have, one by one, consented to abandon the rite ; and from the narrative given in the papers which were published upon this subject by the Government, it does not appear over-sanguine to anticipate, that as regards the tribes which are at all subject to our influence or lie within our reach, the Meriah Sacrifice may be considered to be at an end.

150. If large improvements have been made under the various departments of Civil administration during the last eight years, the military branch of the Service has received its full measure of attention and amendment.

151. The position of the Native Soldier in India has long been such as to leave hardly any circumstance of his condition in need of improvement.

The condition of the European Soldier, on the other hand, was susceptible of great improvement, and has received it liberally. His terms

of service, his food, his lodging, have all been bettered during these years, and infinitely greater care than heretofore has been bestowed upon his occupation, his recreation and his health.

The Regiments in Her Majesty's Service, no longer condemned to the prolonged banishment to which they were formerly subject, are to be relieved every twelve years.

The rations of the European Soldier have been greatly improved.

Strict Rules have been laid down to ensure that the rations should be of proper quality, and, as a further security, a Victualling Sergeant has been attached to European Corps.

The pernicious system under which a morning dram was served out to every Soldier before his breakfast has been abolished.

The use of spirits at all by the Soldier has been discouraged to the utmost.

To that end Malt Liquor is annually imported from England in enormous quantities by the Government, and is served out to the Troops at reasonable rates. The benefits which are likely to arise from the introduction of this change cannot be estimated too highly.

In like manner, to remove from the Soldier temptations to excess under which he lay before, the system which prevails in Her Majesty's Army, of paying the troops daily, has been extended to the troops of the Hon'ble Company.

The lodging of the Soldier has been greatly improved, and no nation can show better or more appropriate quarters for its troops than the Government now provides for European Soldiers in the East.

No Barrack in the Plains is now built with less than twenty-four feet of height within. All are raised from the ground, and every appliance for cleanliness, ventilation, and healthiness, which experience has suggested or ingenuity can devise, is introduced into the buildings.

At Peshawur and in the Hills the height of the Barracks has been adapted to the colder nature of the climate, at the wish of the Military Authorities themselves.

Within eight years new Barracks have been built, or are being built, at Peshawur, Nowshera, Rawul Pindee, Sealkote, Lahore, Rangoon, and Thayetmyo.

Old Barracks have been replaced, or are being replaced, by new buildings at Ferozepore, Subathoo, Kussowlie, Umballa, Agra, Cawnpore, Fort William, Moulmein, and Hyderabad in the Deccan.

In every case, as a general rule, separate Barracks are built for the married men of every Regiment.

Proper provision for washing and cleanliness has been made in all the new plans, and of late Reading Rooms have been included in the design for each Barrack.

The scanty comforts of the Soldier within his quarters have also been increased.

Punkhas are hung in every barrack as in a private house.

In the colder Provinces additional bed covering is now issued, and a certain proportion of fuel is allowed.

A chest, too, is provided for every man at his bed-side by the Government, and canvas bags are supplied for the conveyance of his baggage when marching, instead of the cumbrous wooden boxes which the men dragged with them from station to station, when they were their own property.

Lastly, it has been ordered, that wherever means can be found, swimming-baths shall be constructed for the European Soldiers at every station.

For the instruction of Soldiers and their children, books and stationery and furniture for Regimental Schools are now supplied by the Government; further, a Normal School for training School-masters (Non-Commissioned Officers or Privates) has been attached to the Lawrence Asylum.

For the recreation of the Soldiers, and for encouraging them to useful occupations, Soldiers' Gardens have in some Stations been already formed, and it is intended that a Soldier's Garden should form a part of every Cantonment in which European Troops are quartered.

Work-sheds also have been authorized in connexion with every Barrack, and implements and materials for different kinds of handicraft are to be provided by the Government.

For the encouragement of the class of Non-Commissioned Officers, it has been ordered that Annuities not exceeding £20, should, as in Her Majesty's Service, be granted to Sergeants of the Hon'ble Company's Armies, as rewards for distinguished or meritorious services.

More especially of late years, solicitous care has been shown for the preservation and for the restoration of the health of the European Soldier.

Measures have been taken for the early despatch by steam to the Upper Provinces of all Recruits who arrive from England; and the



departure of the Invalids of every season has been facilitated and expedited by making use of the Indus route.

152. The temporary Barracks run up at Subathoo and Kussoowlie are now being re-placed by buildings of the best description. At Dugshaie magnificent barracks have already been built; three full Regiments, therefore, may now be quartered on the Hills near Simla.

A few years ago the only Convalescent Depôt for European troops was at Landour, above Mussoorie.

A second Depôt was subsequently formed at Darjeeling, for the use of the troops in the Lower Provinces.

The great benefit which was derived from these sanitary Depôts led speedily to an increase in their number.

A Depôt has accordingly been formed at Murree, above Rawul Pindee. Another has been sanctioned in the Chumba Hills, at the head of the Baree Doab. Another is being built at Dhurumsala, near Kangra; and a site has been selected for another in the Hills not far from Nynsee Tal.

153. Much inconvenience having been felt from the tardy system which had been followed in the posting of Cadets, rules were laid down for expediting the posting. At the same time measures were adopted for ensuring the speedy conveyance of all such young Officers to the Regiments to which they had severally been posted.

154. Encouragement was held out to all Officers of the Army to acquire a high knowledge of the Native languages, by the grant of pecuniary rewards to those who should pass examinations of a certain specified standard.

In order to ensure that at least a competent knowledge of the Native languages should be possessed by those appointed to Staff Office or to any detached charge, every Officer was required to pass a prescribed examination in Hindoostanee.

All Officers already holding such appointments who did not pass the examination by a certain date were remanded to their Regiments.

To correct the uncertainty which prevailed in the application of this rule, a fixed standard of proficiency was laid down, and the qualifications of candidates are no longer decided by Station Committees, but by Examiners at Calcutta.

155. The evils inseparable from a seniority system had long been felt, in the advanced age and consequently the frequent incapacity of Officers who succeeded in their turn to Commands of Divisions and

Brigades in the Indian Army: the Government of India at length found it necessary to interfere. The Government declared, that while the claims of seniority in the appointment of Officers to Divisional and Brigade Commands should always be allowed due weight, they should be less deferred to than heretofore. The Government further declared, that, in making such appointments, the governing principle should not be the rejection of no man unless he were notoriously and scandalously incapable, but rather the selection of no man, whatever his standing, unless he was confessedly capable and efficient.

The Supreme Government has done its utmost to act up to this principle in all appointments made since the time at which it was promulgated.

156. The more recent Regulations which have been laid down by the Home Authorities have tended materially to promote the wholesome end of placing high Commands in the hands of such Officers only as are still in the full vigour of their mental and bodily powers.

Those Regulations are a fit subject of congratulation for all who feel an interest in the welfare and efficiency of the Indian Army.

157. The Indian Army, however, has still higher cause for congratulating itself, on the gracious favor which the Sovereign has lately shown towards it, in raising its Officers from the derogatory position in which they have hitherto stood, and in granting to them the recognition, which until now has been denied to them, of their military rank in every part of the British Dominions and throughout the world.

158. The recital of what the Government of the Hon'ble Company has done during the last eight years for the Officers and Soldiers of the Army who serve in India, cannot be more appropriately closed than by making mention of the care it has shown for the Orphan Children of those who have been attached to its Service.

In the belief that the climate of Bengal was enervating and injurious to the health of the children of the Military Orphan School, who have hitherto been collected in an Institution at Calcutta, the Government resolved to move the Lower Orphan School to the climate of the Hills, and to attach it there to the Lawrence Asylum.

This benevolent resolution has been carried into effect, with what benefit to the health and vigor of the children can be fully appreciated only by those who have seen the aspect of the European children in Bengal, and have been able to contrast it with the ruddy, stout, English

appearance of those who from an early age have had the Lawrence Asylum and its mountain climate as their constant home.

159. Since the year 1848, nearly every department connected with the Military branch of the Service has been revised and amended.

At the commencement of the period above-mentioned, and long previously, the control over these several Departments had been committed chiefly to the Military Board.

The constitution of the Board itself was faulty, and the duties which had been imposed upon it were more onerous than could have been well performed by any Board, even if its organization had been good. The Department of Public Works, the Commissariat Department, the Stud Department, the Ordnance Department, with many other duties, all were managed by the Military Board ; and all were managed badly.

The withdrawal of the Department of Public Works from the control of the Military Board, and the reasons for the measure, have already been narrated in a preceding paragraph.

160. A Commission was appointed to enquire into the system of Army Commissariat in Bengal.

The result of the enquiry led to the immediate withdrawal of the Commissariat Department also from the control of the Military Board. Effect was again given to the principle of individual responsibility and individual authority, and the control of the Commissariat Department was entrusted to the Officer at its head, the Commissary General of the Army.

Various amendments of detail were introduced. Great care has been taken in the selection of Officers for the Department, and a rule has been laid down that no Officer shall be confirmed in his appointment until he shall have proved his fitness by passing a searching examination, after a due period of probation.

The Account branch of the Department, which was its weakest point, has been strengthened and completely reformed, by the appointment of a separate Officer of Audit.

Another vital change has been effected by requiring the abolition of Persian Accounts, and by insisting on the rendering of all Accounts at once in English. The success of this change has been complete, and its effects are already strikingly apparent in the prompt rendering of every Monthly Statement, followed by an equally prompt audit.

The substitution of hired cattle for the use of the Government in lieu of animals bred and maintained by the Government itself was a change hardly less important than that which has just before been noted.

Though the measure is described in a single sentence, it has given a large financial saving to the Government, while it has preserved full efficiency in the public carriage of the Army.

The effect of these several changes has been, I sincerely believe, to render the Commissariat Department of the Army as effective, for peace or war, as that of the best organized among the Armies of Europe.

161. The efficacy of the principle of unity of authority and unity of responsibility having thus been recognized, it was speedily extended to other Departments.

At the suggestion of the Hon'ble Court itself, the Stud Department was withdrawn from the control of the Military Board, and was placed under a single head, the Superintendent of Studs.

This department was also subjected to the scrutiny of a Commission.

Various changes were suggested in the Report, some of which have already been effected, while others must, of necessity, be gradually introduced.

162. Lastly, the Ordnance Commissariat Department, with Powder Manufactories, Gun Foundry, and Gun Carriage Agency, was taken from the control of the Military Board, and was placed under the charge of a single Officer, the Inspector General of Ordnance.

163. These great changes having been completed, the Military Board of the Bengal Army was abolished.

The same measure will be carried into effect in the other Presidencies, doubtless, without undue delay.

164. Two other measures connected with military affairs still remain to be noticed.

It had long been known that the punishment of transportation was not viewed with apprehension by the European Soldiers serving in India. On the contrary, it has seemed in many instances to be regarded rather as an advantage to a convict who should be sent from India. The risk of transportation, therefore, had ceased to deter men from crime.

In order to correct this great evil, the Government, at the recommendation of the Military Authorities, has resolved to build a General

Military Prison, where Soldiers, now usually condemned to transportation, may be imprisoned for the long terms to which they may be sentenced.

It is hoped that this measure will check the grave and growing evil which has already been noticed.

165. A great military reform has been effected in the re-organization of the Clothing Department of the Indian Army.

Proceeding on the Report of a Commission appointed to enquire into the working of the former system, the Government of India, with the sanction of the Hon'ble Court, wholly abolished the Off-reckoning Fund.

From the 1st January 1855, the Clothing of the Army has been provided by the State. A fixed sum, calculated on the average of the off-reckoning shares of the preceding twenty-one years, will be paid to Colonels of Regiments, instead of their former shares of the Off-reckoning Fund. The Clothing Board has been dissolved, and the Department has been placed under a Superintendent of Army Clothing alone.

By this measure the system of clothing the Army was freed from many influences calculated to prove injurious to it; great and mischievous delays have been avoided; and the Senior Officers of the Army have been relieved from a position which was frequently and plausibly made a matter of reproach against them.

In effecting this reform, the Government of the Hon'ble Company anticipated the act of the Imperial Government, by whom a similar reform in regard to the Clothing of the Royal Army was determined upon, not long after it had been adopted in India.

166. The Ecclesiastical and the Medical Establishments of the Government being technically attached to the Military Branch of the Public Service, they have not been referred to until now.

The Ecclesiastical Establishment has been largely increased during the last eight years, to meet the additional call for religious instruction which has been created by the formation of many new stations in the several Provinces which have been added to the Empire.

The Court has also given its sanction to the occasional employment of other Clergymen, not being in the Service of the Hon'ble Company, when Chaplains on the Establishment may not be available.

167. The proper provision of places of worship for the servants and soldiers of the Government has been established on a liberal and sure

footing. In every case, in which a place of Protestant worship is required, the Government undertakes to provide one, properly adapted to the purpose, but of the plainest and simplest form. The Government at the same time expects that the community which is to worship therein shall recognize its own obligations, by contributing such sums as shall suffice to meet the charge of giving to the building the ornament and architectural form which befit its sacred character.

Under this Rule, churches have been sanctioned at Peshawur, Rawul Pindee, Murree, Sealkote, Meean Meer, Lahore, Simla, Rangoon, Thayetmyo, Tounghoo, Hyderabad in Sinde, and other places.

168. For the servants of the Government belonging to the Roman Catholic Church most liberal provision has likewise been made.

The Government has lately recognized their claim to obtain from the Government fitting places of worship, on the same conditions as their Protestant brethren.

169. Salaries have been granted to three Roman Catholic Bishops, one in each Presidency, by whom certain duties connected with the business of the Government are performed.

The salaries of the priests have been revised and augmented.

Separate Burial Grounds have been ordered to be set apart for members of the Roman Catholic Church, and every care has been taken by the Government to ensure that the Clergy of that persuasion shall have no just cause to complain of want of due consideration or of inequality of treatment.

170. In the Medical Department, additional advantages have been granted by the Hon'ble Court to Natives who apply themselves to the study of the medical profession, by the allotment of higher allowances than before to the class of Sub-Assistant Surgeons.

171. The establishment of Dispensaries has, probably, been productive of a larger amount of material benefit to the population of India than any other institution which we have introduced among them. It is therefore satisfactory to be able to state, that during these years the number of Dispensaries has been largely increased.

172. The subject of Vaccination, and the question of the best mode of defending the population against the dreadful scourge of small-pox, which commits such havoc among its dense masses, has occupied much of the attention of the Government. Some progress has been already made, and it is believed that general and effectual measures for checking, if not for wholly counteracting, this great evil will yet be devised.

173. In 1853, admission to the Medical Service was thrown open to competition by all classes.

Already one Native of India, Dr. Chuckerbutty, who had been educated in England some years before, has taken advantage of the opening created by Parliament, and has won for himself a Commission as Assistant Surgeon in the Service of the Hon'ble Company.

174. Before resigning the Government of India, I submitted for the consideration of the Council proposals for the enlargement and the improvement of the Medical Service. The proposals met with the entire concurrence of the Council, and have been transmitted to England.

If they should receive the approval of the Hon'ble Court, and should be carried into effect, the Medical Service of the East India Company will then be second to none in the world.

175. During the years that have passed since 1848, the Legislation of the Government of India has embraced a great variety of subjects, and has effected many amendments of the Law. Some of these may be mentioned.

176. Under the head of Criminal Justice and Police, Acts have been passed for the more certain punishment of persons guilty of the crimes of Thuggee and Poisoning, of tampering with the Army or Navy, and of Kidnapping and Crimping.

Acts have also been passed for the punishment of Ministerial and Police Officers guilty of corruption and of public Accountants guilty of default.

Counsel has been allowed by Law to prisoners.

The branding of convicts has been abolished.

Provision has been made for the custody of criminal lunatics.

Better provision has been made for the trial of charges of misconduct brought against public Officers.

On the other hand, protection has been given by Law to public Officers when acting in good faith.

Measures have been taken for the improvement of the administration of Criminal Justice, by defining the powers of the Nizamut Adawlut, by the appointment of Deputy Magistrates in Bombay, and by other minor alterations in all the Presidencies, especially by the concession of criminal powers to Moonsiffs.

Lastly, the power of the Government to grant pardons in all cases has been established by Law.

177. Under the head of Civil Justice and Procedure, Acts have been passed for extending the jurisdiction of Moonsiffs, and for improving the procedure in their Courts.

The mode of procedure in regular and special appeals has been largely amended, and the jurisdiction of the Sudder Courts generally has been defined and improved.

A vast improvement has been made in the Law of Evidence, and in the mode of examining witnesses.

All judicial Officers have been required to write their judgments at once in their own vernacular language.

Administrators General have been appointed at all the Presidencies.

Lastly, Small Cause Courts of extended jurisdiction have been established.

178. The miscellaneous Legislation of the Government of India during this period has been very extensive and various.

Among the principal Acts that may be mentioned, are the new Post Office Act ; the Railway Act ; the Electric Telegraph Act ; the Law for the Regulation of Joint Stock Companies ; the Mofussil Municipal Act ; the Municipal and Conservancy Act for the Presidency Towns ; the Acts for the Regulation of Native Emigration ; the Law empowering the Government to levy Tolls on Roads and Bridges ; the Law for the Education of Minors ; the Indian Marriage Act ; the Law for the Naturalization of Aliens ; the Law rendering British Subjects liable to all Duties and Obligations incident to the Occupation of Land ; the Apprentice Act ; the Act for the Repeal of the Usury Laws.

179. Lastly, an Act has been passed for securing liberty of conscience and for the protection of Converts, and especially of Christian Converts, against injury in respect of property or inheritance by reason of a change in their religious belief.

180. The review, which I proposed to take in this Minute, of the events of the last eight years, and of the fruits they have produced, has now been brought to a close. No attempt has been made to embellish the narrative. It is for the most part a simple recital of what the Government of India has done. If the recital should seem dry in itself, it may be hoped that the results which it exhibits, will not be thought by the Hon'ble Court to be unprofitable or disappointing.



One of the last, and not the least important, of those measures which have emanated from the Government of India during these past years, has been a resolution to require henceforth from the Government of every Presidency, from each Lieutenant-Governor, and from the Chief Officer of every Province, an Annual Report ; narrating the incidents that may have occurred during the year within their several jurisdictions, and stating the progress that may have been made, and all of moment that may have been done, in each principal Department of the Civil and Military Administration.

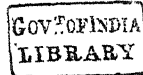
My parting hope and prayer for India is, that, in all time to come, these Reports from the Presidencies and Provinces under our rule may form, in each successive year, a happy record of peace, prosperity, and progress.

(Signed) DALHOUSIE.

*28th February 1856.*

SELECTIONS

FROM



THE RECORDS

OF THE

GOVERNMENT OF INDIA.

(HOME DEPARTMENT.)

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P A P E R S

ON THE

PROPOSED RAILWAY IN BENGAL.

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# REPORT

## ON THE

### PROPOSED RAILWAY IN BENGAL.

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FROM THE CONSULTING ENGINEER TO THE GOVERNMENT  
OF INDIA AND DIRECTOR OF THE RAILWAY DEPARTMENT,

To F. J. HALLIDAY, Esq.,

*Secretary to the Government of India.*

DATED CALCUTTA, 29TH APRIL, 1850.

SIR,

ON the occasion of an interview I had with the Most Noble the Governor General of India, on the 13th instant, I promised his Lordship a full statement of my present views respecting the proposed Railway in Bengal, in extension of a brief memorandum I then laid before him. I have now the honor of submitting the Report through your department as the official channel for this communication to reach his Lordship.

2. For convenience sake, I intend arranging the Report under the following heads:

*First*,—The ultimate object to be attained.

*Second*,—The Bogwangola line considered and disposed of.

*Third*,—The Rajmehal line explained.

*Fourth*,—The best site for a terminus at Calcutta considered.

*Fifth*,—On the breadth of gauge most suitable for the Railways in India.

*Sixth*,—On the permanent way.

*Seventh*,—On the estimated cost of a double and single line.

*Eighth*,—On the extent and route of the experimental Railway with the given capital.

*Ninth*,—A single line of Railway considered.

*Tenth*,—Proposal of a line partly single and partly double.

*Eleventh*,—Comparison of the probable traffic on the two proposed experimental lines.

*Twelfth*,—Another site for the experimental line of Railway pointed out.

*Thirteenth*,—The Government supervision and control, with suggestions thereon.

*Fourteenth*,—Summary of recommendations made in this Report.

#### THE ULTIMATE OBJECT TO BE ATTAINED.

3. The ultimate object to be attained is the construction of a Railway connecting Calcutta with the North-Western Provinces of India, and on such a line, extending as far as Delhi, the important town of Mirzapore would be situated nearly mid-way. Two lines of country have been proposed as the best routes to be followed in laying out such a line of Railway, the one following nearly the direction of the present Grand Trunk Road, between Calcutta and Benares, and called the "*direct route*," and the other following the course of the river Ganges (nearly), and called the "*river route*." The comparative advantages of these routes will hereafter be considered, so far as the imperfect information at command will admit of: in this place, it is only requisite to give tabular statements showing the distances of places on the two lines, and their comparative total lengths.

4. The following Table shows approximately the respective distances of various points on such a line, if taken along the *direct route*:—

| From                           | To                             | Approximate Distances in Miles. | Approximate Distances from Howrah in Miles. |
|--------------------------------|--------------------------------|---------------------------------|---------------------------------------------|
| Howrah, ... ..                 | Burdwan, ... ..                | 62                              | 62                                          |
| Burdwan, ... ..                | Raneegunge, ... ..             | 54                              | 116                                         |
| Raneegunge, ... ..             | Commencement of Behar, ...     | 141                             | 257                                         |
| Commencement of Behar, .....   | Sherghottee, ... ..            | 23½                             | 280½                                        |
| Sherghottee, ... ..            | River Soane, South side, ...   | 42                              | 322½                                        |
| River Soane, South side, ..... | River Soane, North side, ..... | 2¾                              | 324¾                                        |
| River Soane, North side, ...   | Sasseram, ... ..               | 11                              | 335¾                                        |
| Sasseram, ... ..               | Chunar, ... ..                 | 75                              | 410¾                                        |
| Chunar, ... ..                 | Mirzapore, ... ..              | 21                              | 431¾                                        |

| From                                   | To                 | Approximate distances in miles. | Approximate distances from Howrah in Miles. |
|----------------------------------------|--------------------|---------------------------------|---------------------------------------------|
| Mirzapore, ... ..                      | Allahabad, .. ...  | 54                              | 485 $\frac{1}{8}$                           |
| Allahabad, ... ..                      | Futtehpore, ... .. | 73                              | 558 $\frac{1}{8}$                           |
| Futtehpore, ... ..                     | Cawnpore, ... ..   | 49                              | 607 $\frac{1}{8}$                           |
| Cawnpore, ... ..                       | Mynpoorie, ... ..  | 94                              | 701 $\frac{1}{8}$                           |
| Mynpoorie, ... ..                      | Allyghur, ... ..   | 75                              | 776 $\frac{1}{8}$                           |
| Allyghur, ... ..                       | Delhi, ... ..      | 73                              | 849 $\frac{1}{8}$                           |
| Total approximate }<br>length, ..... } | ... ..             | 849 $\frac{1}{8}$               | .....                                       |

5. The following Table shows approximately the respective distances of various points on such a line, if taken along the *river route* :—

| From                             | To                  | Approximate Distances in Miles. | Approximate Distances from Howrah in Miles. |
|----------------------------------|---------------------|---------------------------------|---------------------------------------------|
| Howrah, ... ..                   | Hooghly, ... ..     | 23                              | 23                                          |
| Hooghly, ... ..                  | Culna, ... ..       | 23 $\frac{1}{2}$                | 46 $\frac{1}{2}$                            |
| Culna, ... ..                    | Cutwa, ... ..       | 30 $\frac{1}{2}$                | 76 $\frac{1}{2}$                            |
| Cutwa, ... ..                    | Rajmehal, ... ..    | 108 $\frac{1}{2}$               | 180                                         |
| Rajmehal, ... ..                 | Colgong, ... ..     | 45                              | 225                                         |
| Colgong, ... ..                  | Bhaugulpore, ... .. | 16 $\frac{1}{2}$                | 241 $\frac{1}{2}$                           |
| Bhaugulpore, ... ..              | Monghyr, ... ..     | 35                              | 276 $\frac{1}{2}$                           |
| Monghyr, ... ..                  | Patna, ... ..       | 90                              | 366 $\frac{1}{2}$                           |
| Patna, ... ..                    | Dinapore, ... ..    | 10 $\frac{1}{2}$                | 377                                         |
| Dinapore, ... ..                 | Arrah, ... ..       | 24                              | 401                                         |
| Arrah, ... ..                    | Buxar, ... ..       | 42                              | 443                                         |
| Buxar, ... ..                    | Mogulsarie, ... ..  | 54                              | 497                                         |
| Mogulsarie, ... ..               | Chunar, ... ..      | 19                              | 516                                         |
| Total distance to Chunar, ... .. | ... ..              | 516                             | .....                                       |

6. The distances given in the preceding Tables were taken from the best maps at hand, but as all the maps consulted on the occasion disagreed more or less with each other, no great dependence can be placed



upon the accuracy of the numbers; for this reason they are called approximate distances only, and although they may not be quite correct, yet they are sufficiently so for present purposes, namely, the comparison as respects distance between the *direct* and *river* routes, both Tables being derived from the same sources. Upon examination of the numbers thus given, it will be seen that the whole distance from Howrah to Chunar by the *direct* route is  $410\frac{7}{8}$  miles; and between the same places by *river* route is 516 miles: being  $105\frac{1}{4}$  miles in favour of the direct route. From Chunar onwards to Delhi the line is one and the same, and therefore has not been repeated in the second Table.

7. For the construction of so extensive a line of Railway, a capital of some millions Sterling would be required, but by the agreement between the Hon'ble East India Company, and the East Indian Railway Company, the present expenditure of capital is to be limited to one million Sterling. It follows, therefore, that a small portion only of the above line can be carried into practice.

8. The points settled and determined by the Home Government are as follow:—

*First*,—The capital is to be *one* million.

*Second*,—The Railway is to commence at or near to Calcutta.

*Third*,—The Railway is to consist of a double line of Rails. Recommended, but not ordered, as follows:—

*Fourth*,—The weight of the rails to be 84 lbs. per lineal yard.

*Fifth*.—The gauge of the rails to be the narrow one, *viz.*, 4 feet  $8\frac{1}{2}$  inches.

9. The question to be at present settled therefore appears to be, how many miles of Railway commencing at Howrah (for reasons presently to be given) can be constructed with the said one million Sterling, including the station, sheds, engines, carriages, workshops, tools, and every appliance for carrying on the traffic of the line, and also the expense of direction and management both in India and in England.

#### THE BOGWANGOLA LINE CONSIDERED AND DISPOSED OF.

10. It may be asked why I have assumed that the line must start from Howrah, and take the right bank of the river, instead of starting at once from Calcutta, and proceeding up the left bank, through Barrackpore, Ranaghât, Kishnagur, and Berhampore to the river

Ganges, at or near to Bogwangola?—that being the shortest route from Calcutta to the great River Ganges, and Bogwangola being a considerable mart on its banks. The reasons are, that the engineering works would be both heavy and insecure, and there would be no effective terminus on the banks of the Ganges at the proposed locality, as will appear from the following facts :—

11. First, there would be the crossing of the River Matabangha, by no means a trifling work, it being about 500 feet in breadth, and next there would be that of the Jellinghee, which in addition to its requiring a large and expensive structure (about 1,200 feet long, being within 80 feet of the same length as Waterloo Bridge at London,) would be attended with the uncertainty of the river keeping to its present bed, for there are clear indications of its having changed it repeatedly: and if such an event were again to occur after the construction of the Railway, the destruction of a portion of it would be the consequence, and a very large additional outlay of money would be necessary for its restoration. And furthermore much of the remaining country between the Jellinghee and Bogwangola bears the appearance of having been traversed in former times by the neighbouring rivers, and therefore may be so again.

12. Besides the foregoing objections, there is another of no small moment, *viz.*, there is no permanent point on that part of the banks of the Ganges for a terminus which would be certain at all times to be available, because the current of the river thereabouts is continually changing its direction; at one season it is close, or near to the Bogwangola shore, at another, and more generally, it is far distant therefrom; so that in the dry season, the Railway terminus would, as past experience has shown, be mostly separated from the water of the river by an intervening bed of sand, one, two, or more miles in breadth, an insuperable objection to a Railway terminating there.

13. The considerations above set forth appear to dispose of the project for a Railway from Calcutta to Bogwangola which found favor in the eyes of the multitude in 1845-46, upon an alluring promise in a prospectus of profit of 65 per cent. per annum on the gross capital £1,500,000. A considerable sum of money was paid by the public as deposits on shares,—a splendid entertainment was given by the promoters of the scheme at the Town Hall, to celebrate so important an era in Railway history,—the leading actors subsequently vanished, and nothing more has since been heard of the project.

## THE RAJMEHAL LINE EXPLAINED.

14. A project has been advanced for a Railway from Calcutta to Rajmehal, where a favorable spot for a terminus on the banks of the Ganges really can be had. Such a line would take the general direction proposed by Lieutenant Colonel Forbes for a canal between that place and the river Hooghly. Such a Railway might advantageously have its terminus at Howrah, opposite Calcutta, and the length of a line from thence to Rajmehal would be about 180 miles.

15. My opportunities hitherto have enabled me to explore but a small portion (about one-third) of the line of country a Railway from Howrah to Rajmehal would traverse, and therefore I can only judge of its capabilities from the Survey and Reports of Colonel Forbes for the canal above-named, and judging therefrom, I can have no doubt of the practicability of the project, although there will be some few expensive works, as the crossing of the Adjai, &c.

16. The line to Rajmehal was originally proposed to relieve the Ganges traffic passing down to Calcutta, which now, in consequence of the natural impediments to the free navigation of the Bhageeruttee River during the dry season (a large portion) of the year, has to pass through the wilderness of the Sunderbunds to the river Hooghly, which is not only a dangerous navigation, but extends the voyage a no less distance than about 308 miles.

17. It has also been proposed that the line to Rajmehal be continued along the valley of the Ganges to the North-Western Provinces, on the ground (as its advocates say) of its accommodating more valuable and important districts of country than would be done by the direct route. The approximate distance on such a line from Calcutta to Delhi is given in the Tables at para. 5, a similar Table of distance on the direct route being also given in para. 4.

## THE BEST SITE FOR A TERMINUS AT CALCUTTA CONSIDERED.

18. The Home authorities have determined that whatever length of the line may be constructed, one of its termini shall be at, or near to, Calcutta; and as the starting from Calcutta itself would involve the construction of a bridge across the River Hooghly, which with so small a capital as one million Sterling is quite out of the question, I have assumed Howrah in the Tables, (paras. 4 and 5,) as the proper starting-point; which place being immediately opposite to Calcutta may be

easily connected therewith by a steam-ferry, or floating bridge, such as are in use at several places in England.

19. But it may be said, there is no necessity for constructing a bridge over the Hooghly at all, as the Railway trains might be passed over the river at Pultah Ghât on a floating Railway craft worked by steam-power, in the manner they now cross the Forth in Scotland, and, I believe, some other estuaries in Great Britain.

20. The adoption of such a plan in the present instance would be attended with but small advantage in comparison with its disadvantages, as will now be shown :—*firstly*, it would occasion a large preliminary outlay, and a considerable permanent expense to the Railway Company, in constructing, maintaining, and working such a craft, with the necessary landing-wharfs on both sides of the river; and *secondly*, the transit of the trains would be attended with some delay and danger, and that almost immediately after starting; and *thirdly*, a terminus on the Calcutta side must, under existing circumstances, be inconveniently situated for the public, (as will be shown in the next para. ; ) and all for the doubtful advantage of avoiding the necessity for passengers crossing from Calcutta to Howrah in a convenient steam ferry-boat before joining the Railway, which would enable them to proceed on their journey without let or hindrance, and without entailing any expenditure on the Railway Company, which the plan described in the last para. would occasion.

21. But even admitting that the above objections to passing the trains across the river in a steam Railway craft be overruled, there still remains a formidable objection to starting the Railway from the Calcutta side of the Hooghly, inasmuch as the terminus must be situated at the Northern or Chitpore extremity of the town, a distance of  $3\frac{1}{2}$  miles from the Custom House, or the commercial focus of the town; for any attempt to bring the Railway into Calcutta, to locate the terminus in a central situation, would make a large inroad upon the capital of the Railway Company (one million Sterling) in the form of compensation for much valuable property.

22. There is another way by which the terminus might be stationed a little nearer to the centre of trade without interfering with the property in the town, namely, by locating it beyond the town to the Eastward, on the road leading to the Salt-Water Lake, in continuation of the Boitakannah, and Bow Bazar Roads.

23. But a terminus situated as last named would still be about

1 $\frac{5}{8}$  miles from the centre of business, which I take to be about Tank Square, or the Custom House, and only about 1 $\frac{1}{2}$  miles less distant than at Chitpore, to obtain which advantage there must be constructed at least 2 $\frac{1}{2}$  miles of more expensive Railway, as it would pass through the suburbs of the town, and involve the crossing of the Circular Canal, unless it be carried three quarters of a mile still further from Calcutta to the Eastern side of the said canal. Furthermore, a terminus placed anywhere to the East of the town would suffer the great disadvantage of being very distant from the river, with which it could only communicate by means of the Circular Canal, a poor substitute for the benefit derivable from a station on the bank of the Hooghly, in the centre of the port of Calcutta, as the site at Howrah would be. These considerations will probably be considered fatal to placing the terminus to the Eastward of the town.

24. All things considered, it appears pretty obvious that Howrah is the most suitable locality for the Railway terminus, when the whole capital is so small as one million Sterling. For it would be situated on the bank of the river, and on that side where deep water exists, consequently is suitable for the erection of a pier, or wharf for craft of various kinds to come alongside, and take in cargo, or discharge at once into the Railway trucks, all which is of no small importance at a commercial port like Calcutta.

25. Again the terminus could be placed opposite to the most central part of the town, and by means of a well-managed steam-ferry, (which could also be available to the public generally,) the Railway passengers would effect the crossing of the river without difficulty or inconvenience, both before joining, and after quitting the Railway; consequently neither delay to the trains, nor expense to the Railway Company would accrue from the passage of the river, as would be the case if the crossing of the trains a few miles from Calcutta be adopted.

26. The practice of passing great rivers with Railway trains, in the manner under discussion, is not adapted for places situated so few miles distant as Pultah is from Calcutta (about 16 miles), the latter having such a place as Howrah opposite to it, but would be very applicable in the case of crossing the Jumna at Allahabad, or the river Soane, if it contained water enough for that purpose at all seasons of the year, for such a break in the continuity of the Railway about the middle, or one-third the distance of so long a line, is of small importance, compared with what it would be within sixteen or twenty miles of the terminus.

27. I have thought it necessary to enter upon the subject of the Calcutta terminus at some length, because in a Report addressed to W. Grey, Esq., Private Secretary to Sir T. Herbert Maddock, the late Deputy Governor of Bengal, dated 22nd of May, 1846, I expressed myself in favor of bringing the Railway into the heart of the town, and it is therefore due to myself now to state that when that Report was penned, there appeared to be every probability of an abundance of money to carry out the whole of the Railway project from Calcutta to Delhi, and with bridges spanning the great rivers, the Jumna, Soane and the Hooghly, and therefore in so magnificent a project, the extra outlay (large as it would necessarily be) to make so great a work quite complete by bringing the Railway into the heart of the town, would, under such circumstances, be quite unworthy of consideration in comparison with the whole cost of the undertaking.

28. Upon the preceding considerations, I have, in following my investigations, considered Howrah as the proper site for the Railway terminus,—no other plan appearing so feasible under existing circumstances.

#### ON THE BREADTH OF GAUGE MOST SUITABLE FOR THE RAILWAYS IN INDIA.

29. It is highly desirable in a country like India, where the Railway system is now for the first time being introduced, and which will ultimately extend throughout the land, that one uniform standard of gauge should be adopted, and in no case to be departed from, so that whenever the various lines, now and hereafter to be constructed, shall meet and unite, as they assuredly will do, the facilities for transport, which is the great principle of Railway practice, may experience neither check nor inconvenience.

30. The question therefore arises, what width is the most desirable to adopt as the standard of gauge? The Hon'ble Court of Directors, in their Despatch dated 14th November, 1849, para. 13, have expressed themselves as disposed to recommend (but did not order) the adoption of that known in England as the narrow gauge, *viz.*, 4 feet 8½ inches; but with all due respect to the recommendation so given, I beg to state that in my judgment a wider gauge would be preferable for this country, and I would recommend the adoption of 5 feet 6 inches, or thereabouts, as I am not disposed to contend about an inch or two more or less, as I consider that immaterial.

31. After the labours of the gauge commissioners, and the several Parliamentary investigations on the subject of the width of gauge, the results of which are before the world, it would be waste of time to enter upon the discussion in this place.

32. The wider gauge, of 5 feet 6 inches, which I would recommend for adoption (as the Court of Directors have not definitively settled the question), will give  $9\frac{1}{2}$  inches more space for the arrangement of the several parts of the working gear of the locomotive engines, and this additional space will be more needed in India than in Europe, not only on account of machinery itself, but it would lower the centre of gravity of both the engines and carriages, the result of which would be to lessen their lateral oscillation, and render their motion more easy and pleasant, and at the same time diminish the wear and tear.

33. The lowering of the centre of gravity consequent upon the adoption of the wider gauge appears to me of great importance for another reason, namely, the fearful storms of wind so frequent in certain seasons of the year; and I think it very probable that in one severe North-Wester, not to mention such hurricanes as that of 1842, the additional  $9\frac{1}{2}$  inches of base might make all the difference between the safety and destruction of the trains; and one such accident, attended as it doubtless would be with great loss of life, would probably retard the progress of the Railway system in this country very considerably.

34. The additional outlay of capital attendant upon the adoption of a 5 feet 6 inches gauge above that on one of 4 feet  $8\frac{1}{2}$  inches in the first instance would be but trifling, in comparison with what appears to me its more decided advantages.

35. The width of gauge here recommended was the one I selected in my own mind soon after my arrival in India in 1845, and my subsequent experience of the country has confirmed my early views on this point. It was the width I then named (as the one I intended to recommend for adoption when the proper time arrived for so doing), to the Managing Director of the East Indian Railway Company, and by him subsequently named as the intended gauge in his communications with his Company.

#### ON THE PERMANENT WAY.

36. To have a good and substantial Permanent Way is of the greatest importance; far more so than is generally supposed by inexperienced

persons ; I consider that a good Permanent Way is the foundation of the well or ill-doing of a Railway, and cannot be too much attended to, experience having shown that a niggardly expenditure in this respect, either in its first cost, or subsequent maintenance, is a false and mistaken economy.

37. I am glad to find that the Court of Directors appear to entertain the like opinion, for in the 13th para. of their Despatch of 14th November, 1849, they say, " With respect to the weight of rails and gauge of the line to be employed on these Railways, we are disposed "to recommend those used by the North-Western Company here, "namely, a gauge of 4 feet  $8\frac{1}{2}$  inches, and a weight of rails of 84 lbs. to "the yard, as combining the greatest utility and economy." As to the width of gauge named in this extract, I have given my opinion in the preceding paras, but with respect to the weight of the rails, 84 lbs. to the yard, I would also most strongly recommend their adoption, as combining the greatest utility and ultimate economy.

38. By the adoption of lighter rails a saving might be effected in the first instance, but impressed as I am with the importance of having a substantial Permanent Way, I am inclined to disregard any such saving in comparison with the whole cost, and the solid advantages to be derived from having good upper works to the Railway, both as to ultimate outlay and comfort and safety in travelling. For if light rails be adopted with a view to economy in the first cost, upon the supposition that the traffic will be light, and the expectations of the promoters of the Railway should be realized as to the extent of traffic coming on the line, such light rails must be replaced by stronger and of course heavier metal, and necessarily at a great additional cost.

39. The above opinion is founded on the supposition (or belief) that the length of the Railway is not to be limited to the expenditure of one million Sterling, except as an experiment, and that experiment merely as to the engineering part of the question only.

40. The following Tables show the saving on account of rails in the first cost per mile of Railway by adopting lighter rails than the 84 lbs. rail recommended above, both on a double and a single line of Railway :—



*Saving on a Double Line.*

| Weight of Rails per yard in lbs. | No. of Tons required per Mile, allowing for Sidings. |             |            | Total Cost at £7-15-0 per Ton. |           |           | Saving per mile by adopting Lighter Rails than 84 lbs. |           |           |
|----------------------------------|------------------------------------------------------|-------------|------------|--------------------------------|-----------|-----------|--------------------------------------------------------|-----------|-----------|
| <i>lbs.</i>                      | <i>Tons.</i>                                         | <i>cwt.</i> | <i>qr.</i> | £                              | <i>s.</i> | <i>d.</i> | £                                                      | <i>s.</i> | <i>d.</i> |
| 84                               | 266                                                  | 1           | 1          | 2,061                          | 19        | 8½        | 0                                                      | 0         | 0         |
| 75                               | 238                                                  | 0           | 0          | 1,844                          | 10        | 0         | 217                                                    | 9         | 8½        |
| 70                               | 222                                                  | 0           | 2          | 1,720                          | 13        | 10½       | 341                                                    | 5         | 9¾        |
| 65                               | 206                                                  | 0           | 2          | 1,596                          | 13        | 10½       | 465                                                    | 5         | 9¾        |
| 60                               | 190                                                  | 0           | 3          | 1,472                          | 15        | 9¾        | 589                                                    | 3         | 10½       |
| 55                               | 174                                                  | 1           | 0          | 1,348                          | 17        | 9         | 713                                                    | 1         | 11½       |
| 50                               | 158                                                  | 1           | 2          | 1,225                          | 1         | 7½        | 836                                                    | 18        | 0¾        |

*Saving on a Single Line.*

| Weight of Rails per yard in lbs. | No. of Tons required per Mile, allowing for Sidings. |             |            | Total Cost at £7-15-0 per Ton. |           |           | Saving per Mile by adopting Lighter Rails than 84 lbs. |           |           |
|----------------------------------|------------------------------------------------------|-------------|------------|--------------------------------|-----------|-----------|--------------------------------------------------------|-----------|-----------|
| <i>lbs.</i>                      | <i>Tons.</i>                                         | <i>cwt.</i> | <i>qr.</i> | £                              | <i>s.</i> | <i>d.</i> | £                                                      | <i>s.</i> | <i>d.</i> |
| 84                               | 134                                                  | 1           | 1          | 1,038                          | 19        | 8½        | 0                                                      | 0         | 0         |
| 75                               | 120                                                  | 0           | 1          | 930                            | 1         | 11½       | 108                                                    | 17        | 9         |
| 70                               | 112                                                  | 0           | 1          | 868                            | 1         | 11½       | 170                                                    | 17        | 9         |
| 65                               | 104                                                  | 0           | 1          | 806                            | 1         | 11½       | 232                                                    | 17        | 9         |
| 60                               | 96                                                   | 0           | 1          | 744                            | 1         | 11½       | 294                                                    | 17        | 9         |
| 55                               | 88                                                   | 0           | 1          | 682                            | 1         | 11½       | 356                                                    | 17        | 9         |
| 50                               | 80                                                   | 0           | 1          | 620                            | 1         | 11½       | 418                                                    | 17        | 9         |

41. If the traffic on the Railway should ultimately prove so light as not to require rails so heavy as the lightest in the above Table, *viz.* 50 lbs. to the yard, it is certain that the traffic will fall very far short of the amount expected by the promoters of the Railway, and in all probability would require *no rails* at all, or in other words, the Railway would be a losing concern: but if we are to give credit to the original statements of the said promoters of the Railway with respect to the expected traffic, the saving effected by the adoption of either of the lighter rails named in the above Table would very probably, within a short time,

be shown by the result to be a mistaken piece of economy, and the most expensive in the end.

42. With the heavier rails, heavier chairs will be required, and I think that a less weight than 38 lbs. for the joint chairs, and 21 lbs. for the intermediate chairs would not be advisable to employ with the 84 lbs. rail,—and these weights were adopted in framing the approximate estimates presently to be given.

#### ON THE ESTIMATED COST OF A DOUBLE AND SINGLE LINE.

43. The following estimates are only approximate; indeed, it is impossible to make an estimate for such a work otherwise before the intended line of Railway is laid out, and the detailed surveys and sections made, for until that be done the extent of the requisite works can be little more than guessed at. The Permanent Way is the only part of the work which can be estimated for, at the present time, with any degree of certainty as to the quantity of work to be performed, but not as to cost, owing to the fluctuating price of iron :—

44. Approximate estimate of a double line per mile :—

|                                                                                                                                                                                                                                                                  |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Earth-work, bridges, culverts, road-crossings, &c. &c.,                                                                                                                                                                                                          | £2,000 |
| Fencing, both permanent and temporary, . . . . .                                                                                                                                                                                                                 | 100    |
| Permanent Way, . . . . .                                                                                                                                                                                                                                         | 6,167  |
| Working stock, <i>viz.</i> ,—                                                                                                                                                                                                                                    |        |
| Stations, sheds, workshops, locomotive engines, carriages, luggage vans, goods waggons, trucks, coal waggons, fixed engines, water tanks, cranes, turn tables, switches, pumps, goods cranes, tools, signal and miscellaneous machinery, buildings, &c., . . . . | 1,700  |

#### MANAGEMENT.

|                                   |         |
|-----------------------------------|---------|
| In England, per annum, . . . . .  | 2,930   |
| India, . . . . .                  | 5,100   |
| Engineering, . . . . .            | 5,400   |
|                                   | <hr/>   |
|                                   | £13,430 |
|                                   | <hr/>   |
| Or for 2 years, . . . . .         | 26,860  |
|                                   | <hr/>   |
| Or per mile of Railway, . . . . . | 270     |
|                                   | <hr/>   |
| Total per mile, . . . . .         | £10,237 |

But it must be understood that the above, and the following estimates are for a cheap portion only of the line to Delhi, and must not be taken as the average cost of the whole line.

45. Approximate estimate of a single line per mile,—

|                                                         |        |
|---------------------------------------------------------|--------|
| Earth-work, bridges, culverts, road-crossings, &c. &c., | £1,700 |
| Fencing, both permanent and temporary, .. .. .          | 100    |
| Permanent Way, .. .. .                                  | 3,303  |

Working stock, *viz.*,—

|                                                                                                                                                                                                                                                                |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Stations, sheds, workshops, locomotive engines, carriages, luggage vans, goods waggons, trucks, coal waggons, fixed engines, water tanks, cranes, turn tables, switches, pumps, goods cranes, tools, signal and miscellaneous machinery, buildings, &c., .. .. | £1,300 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|

MANAGEMENT.

|                             |        |
|-----------------------------|--------|
| In England, per annum... .. | £2,930 |
| India, .. .. .              | 5,100  |
| Engineering, .. .. .        | 5,400  |
|                             | <hr/>  |
|                             | 13,430 |

Or for 2 years, .. .. . 

---

 £26,860

Or per Mile of Railway, .. .. . 

---

 £270

Total per Mile, .. .. . £6,673

46. In the short memorandum alluded to in the 1st para., the rough estimates therein given were in excess of those contained in the preceding paras., but upon more deliberate consideration I believe the present figures are the most correct approximations of the two.

47. The price of Rails in England I have taken, in the foregoing estimates, at £7 15s. per ton, which is very low, for within the last few years it has reached £12 per ton, which on the other hand was very high, and although I believe £7 15s. to have recently been about the price in England, yet it would be too much to expect that so low a rate will be maintained for any length of time, or that much of the Railways in India will be supplied at so low a figure; the same remarks apply also to the cast-iron chairs, which I have taken in the above estimates at £5 10s. per ton in England. In the following

paragraph is a Table showing the increase that would take place in the estimate for the Permanent Way both for a double and single line of Railway upon an increase in the price of iron.

48. Table showing the increase on the total of the preceding estimates upon an increase in the price of iron—

*Double Line.*

| Increase in<br>Price per<br>Ton. | Total Increase in the above Estimate. |    |                  |         |    |                  | Total Increase on the<br>Estimate. |
|----------------------------------|---------------------------------------|----|------------------|---------|----|------------------|------------------------------------|
|                                  | Rails.                                |    |                  | Chairs. |    |                  |                                    |
| £ s.                             | £                                     | s. | d.               | £       | s. | d.               | £ s. d.                            |
| 0 5                              | 66                                    | 10 | 3 $\frac{3}{4}$  | 20      | 6  | 9 $\frac{3}{4}$  | 86 17 1 $\frac{1}{2}$              |
| 0 10                             | 133                                   | 0  | 7 $\frac{1}{2}$  | 40      | 13 | 7 $\frac{1}{2}$  | 173 14 3                           |
| 0 15                             | 199                                   | 10 | 11 $\frac{1}{4}$ | 61      | 0  | 5 $\frac{1}{4}$  | 260 11 4 $\frac{1}{2}$             |
| 1 0                              | 266                                   | 1  | 3                | 81      | 7  | 3                | 347 8 6                            |
| 1 5                              | 332                                   | 11 | 6 $\frac{3}{4}$  | 101     | 14 | 0 $\frac{3}{4}$  | 434 5 7 $\frac{1}{2}$              |
| 1 10                             | 399                                   | 1  | 10 $\frac{1}{2}$ | 122     | 0  | 10 $\frac{1}{2}$ | 521 2 9                            |
| 1 15                             | 465                                   | 12 | 2 $\frac{1}{4}$  | 142     | 7  | 8 $\frac{1}{4}$  | 607 19 10 $\frac{1}{2}$            |
| 2 0                              | 532                                   | 2  | 6                | 162     | 14 | 6                | 694 17 0                           |
| 2 5                              | 598                                   | 12 | 9 $\frac{3}{4}$  | 183     | 1  | 3 $\frac{3}{4}$  | 781 14 1 $\frac{1}{2}$             |

*Single Line.*

| Increase in<br>price per<br>Ton. | Total Increase in the above Estimate. |    |                  |         |    |    | Total Increase on the<br>Estimate. |
|----------------------------------|---------------------------------------|----|------------------|---------|----|----|------------------------------------|
|                                  | Rails.                                |    |                  | Chairs. |    |    |                                    |
| £ s.                             | £                                     | s. | d.               | £       | s. | d. | £ s. d.                            |
| 0 5                              | 33                                    | 10 | 3 $\frac{3}{4}$  | 9       | 15 | 6  | 43 5 9 $\frac{3}{4}$               |
| 0 10                             | 67                                    | 0  | 7 $\frac{1}{2}$  | 19      | 11 | 0  | 86 11 7 $\frac{1}{2}$              |
| 0 15                             | 100                                   | 10 | 11 $\frac{1}{4}$ | 29      | 6  | 6  | 129 17 5 $\frac{1}{4}$             |
| 1 0                              | 134                                   | 1  | 3                | 39      | 2  | 0  | 173 3 3                            |
| 1 5                              | 167                                   | 11 | 6 $\frac{3}{4}$  | 48      | 17 | 6  | 216 9 0 $\frac{3}{4}$              |
| 1 10                             | 201                                   | 1  | 10 $\frac{1}{2}$ | 58      | 13 | 0  | 259 14 10 $\frac{1}{2}$            |
| 1 15                             | 234                                   | 12 | 2 $\frac{1}{4}$  | 68      | 8  | 6  | 303 0 8 $\frac{1}{4}$              |
| 2 0                              | 268                                   | 2  | 6                | 78      | 4  | 0  | 346 6 6                            |
| 2 5                              | 301                                   | 12 | 9 $\frac{3}{4}$  | 87      | 19 | 6  | 389 12 3 $\frac{3}{4}$             |

49. It may also be as well to state that I arrived at the estimated cost of management thus,—I assumed that the line constructed with the one million capital will occupy two years in making, and that it will be 100 miles in length, which is sufficiently near the truth for this purpose. The items of expenditure on account of management are many of them also necessarily assumed, but I am inclined to believe that they do not exceed what the actual expenditure on this account will be; they are as follows :—

## IN ENGLAND.

|                                                |          |
|------------------------------------------------|----------|
| Direction per annum, .. .. .                   | £1,100   |
| Secretary, .. .. .                             | 700      |
| Accountant and Clerks, .. .. .                 | 800      |
| Office-Rent, .. .. .                           | 130      |
| Messengers, Advertisements, Printing, &c. &c., | 200      |
|                                                | — £2,930 |

## IN INDIA.

|                                                                              |          |
|------------------------------------------------------------------------------|----------|
| Managing Director, .. .. .                                                   | £2,500   |
| Deputy Ditto, .. .. .                                                        | 1,400    |
| Secretary, .. .. .                                                           | 600      |
| Accountant, .. .. .                                                          | 300      |
| Establishments, Office-Rent, Advertisements,<br>and Stationery, &c., .. .. . | 300      |
|                                                                              | — £1,500 |

## ENGINEERING.

|                                                                                            |          |
|--------------------------------------------------------------------------------------------|----------|
| Consulting Engineer in England, Engineer-in-<br>Chief in India, and Executive Engineer, .. | £5,000   |
| Draftsmen, Overseers, &c., &c., .. .. .                                                    | 500      |
|                                                                                            | — £5,500 |
| Per annum, .. .. .                                                                         | £13,530  |
| For two years, .. .. .                                                                     | £27,060  |
| Or per mile, .. .. .                                                                       | £270     |

ON THE EXTENT AND ROUTE OF THE EXPERIMENTAL RAILWAY, WITH  
THE GIVEN CAPITAL.

50. I have been considering that the capital to be expended is *one* million Sterling; it must, however, be borne in mind that there will not be quite that sum to expend on the works of the Railway, there having been a certain amount already expended on preliminary surveys, &c. The Hon'ble Court of Directors of the East India Company, in their agreement with the Railway Company dated 17th August, 1849, approve of the sum of £33,600 being charged under that head as the expenditure prior to the 28th of March, 1849, since which, upwards of another year has elapsed, and several months more must pass over before a commencement can be made; therefore in all probability that sum will have been increased to at least £50,000 before the works of the Railway will have actually been begun. The available capital, therefore, for the construction of the Railway will be about £950,000, at which I will assume it.

51. Adopting the foregoing approximate estimates, it can be determined how many miles of Railway commencing at Howrah can be constructed with the capital of £950,000, which is as follows:—

|                         | <i>Miles.</i> |
|-------------------------|---------------|
| Of double line, .. .. . | 92.80         |
| Of single line, .. .. . | 142.36        |

52. Rejecting the Bogwangola project altogether, we have the lines named in the second para. *viz.*, the direct and river routes, both starting from Howrah, to determine upon which of them it would be most advantageous to expend the £950,000.

ON THE DIRECT LINE.—53. Such a Railway, double line (that being the orders of the Court of Directors), would extend to about 30.8 miles beyond the station of Burdwan, and fall short of the Coal-fields at Raneegunge by about 23.2 miles,—(see the map accompanying this report.)

ON THE RIVER LINE, OR ON THE LINE TO RAJMEHAL.—54. Such a Railway would extend to about 16 miles beyond Cutwa, and be less than 3 miles in excess of half the distance to Rajmehal, of which place it would fall short by about 87.2 miles,—(see the map accompanying this report.)

55. Thus it appears that upon either of the two routes, a double line of Railway (extending about 92.8 miles from Howrah,) would

terminate at no particularly useful point. But the terminus at the end of 92.8 miles on the *direct* route, (on the Trunk Road) would be much more useful than the terminus situated at the same distance from Howrah, on the River route, or on the way to Rajmehal, because the former would be on the great road to the North-West of India, and so far as it would go must necessarily be useful, being nearly one-fourth of the distance to Benares, which is 413 miles from Calcutta; whilst the latter, without being of any use in that respect, would fall far short of the difficulties in the navigation of the Bhageeruttee River, and therefore would not relieve the traffic on the River Ganges in the least, which traffic would have to make the circuitous route of the Sunderbunds as at present.

#### A SINGLE LINE OF RAILWAY CONSIDERED.

56. I approach the consideration of the adoption of a *single* in preference to a *double* line, on account of the smallness of the sanctioned capital with some difficulty, because the Court of Directors, in the Despatch before referred to, paragraph 11, state they "are clearly of opinion, "that although it would be a slight saving of outlay in the first place, "it would be unwise to make the experiment upon a single line," and then follows some excellent reasons for arriving at such a conclusion. Having already shown how far the capital at our disposal will probably carry a double line, I will, with all due deference, now show how much farther a relaxation of the Court's order on this head will extend the benefit of Railway communication.

57. But first I will observe, that I think the Court are mistaken when they say, in the 11th paragraph of the above-quoted Despatch, "the "réal saving of capital would be very little," and "would amount to "little more than £1,000 or £1,200 a mile,"—the earth-work and bridges, &c., being constructed suitable in width to receive a double line hereafter, if necessary. The saving of outlay in the first instance, under such circumstances, would certainly amount to no more than the difference in the cost of the Permanent Way between a double and a single line, which difference I make to be £2,863 7s. 10d. per mile,—see abstracts of estimates in paragraphs 44 and 45, and the explanation thereof in paragraphs 43, 46, 47, &c. But if the earth-work and bridges, &c., were constructed only for a single line, and with a suitable working stock, the saving would be still greater, namely about £3,564 per mile.

58. A single line of Railway with a suitable working stock would cost per mile as follows :—

No. 1.—With the embankments and brick-work } £6,973  
for a double line, ... .. }

No. 2.—With the whole of the works adapted } £6,673  
for a single line only, ... .. }

And a capital of £950,000 would construct miles of such lines as follows :

No. 1.—With the embankments and brick- } 136 miles.  
work for a double line, about ... .. }

No. 2.—With the whole of the works adapted } 142 „  
for a single line, about... .. }

59. A single line of Railway therefore made, throughout its length similar to No. 1 in the last paragraph, would reach into the mineral districts on the direct route, and extend 26 miles beyond the Raneeunge Collieries, and reach well into the Coal district. But on the route to Rajmehal it would fall short of that place by 44 miles.

#### PROPOSAL OF A LINE PARTLY SINGLE AND PARTLY DOUBLE.

60. With a view to meet the wishes of the Court of Directors, and at the same time obtain a Railway to the Collieries, the line might be made *double* for a portion of the distance, and the remaining portion might be made *single* ; such an arrangement would give a double line where it would be most needed, and the portion of single line would occasion no inconvenience to a well-regulated traffic.

#### COMPARISON OF THE PROBABLE TRAFFIC ON THE TWO PROPOSED EXPERIMENTAL LINES.

61. To determine upon which of the two routes under discussion our capital would be the most advantageously expended, is of some consequence, inasmuch as it is very desirable that the first sample of Indian Railways should, if possible, be remunerative, for it is not merely a work of engineering skill that we are desirous of exhibiting to the native community, but to show them that Railways are attended with both commercial advantages to the country, and profit to the shareholders, with a view to encourage the extension of the Railway system ; I regret, however, that I am the reverse of sanguine on this head with so small a capital as one million, upon the wide-spread traffic of so great a country, whether it be expended on a double or single line.

62. Be it understood that the object of this Report is not to determine the question whether this or that experimental line of Railway



will be *absolutely* remunerative, because it has been determined by the highest authorities that such a Railway *shall* be made, and also that it shall commence, at or near to Calcutta; my business therefore, as I consider it, is to show to the Government of India which of the proposed routes will be the *most* remunerative, and which of course will also be the most beneficial to the public, the Railway Company, and to the Government.

63. If it were my business to determine whether either of the lines would be *absolutely* remunerative, I must first obtain more accurate and detailed surveys than are now at my command, and also must make minutely correct estimates of the cost of the works, and likewise of the expense of working, maintaining, and managing the line after its construction. These particulars, compared with equally full and correct statistics of the existing traffic, would determine the probable value of the Railway as a commercial speculation.

64. But I have only to show by comparison upon which of the two lines the largest amount of traffic is to be expected, supposing the cost of construction to be the same mile for mile on both, and leaving the working expenses out of consideration altogether, as having nothing to do with our present inquiry; I must however observe, with respect to the cost of construction, that although I consider it is sufficiently near for present purposes to assume it equal on both lines, yet in reality I think the route towards Rajmehal would require the construction of larger, and therefore more expensive, works than would be requisite on the direct route.

PROBABLE TRAFFIC ON THE DIRECT LINE,—COAL.—65. The average quantity brought to Calcutta is 22 lacs of maunds, or 81,482 tons, which at  $1\frac{1}{2}d.$  per ton per mile, or  $10s. 10d.$  the whole distance, would produce £44,136.

SALT.—The extent of country the Railway would supply, I reckon to be about 18,000 square miles, and taking the population as obtained from the Bengal Secretariat at 160 to the square mile, gives a total of 2,880,000 souls; now allowing 12lbs. of salt per head, gives a trade in that article of 15,428 tons,\* which at  $1\frac{1}{2}d.$  per ton per mile would produce £11,185 per annum.

MISCELLANEOUS GOODS.—Mr. Adams, of the Railway Company, has given me a statement, made from actual observation, of the number of

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\* Mr. Beadon informs me that the Salt Department issued protection documents for 13,019 tons of salt during the last 12 months, to be conveyed into the districts in question.

loaded hackeries passing along the Trunk Road between Hooghly and Burdwan, of which the following is an abstract :—

|                                              | TRAFFIC.          |                   |
|----------------------------------------------|-------------------|-------------------|
|                                              | Up.               | Down.             |
|                                              | <i>Hackeries.</i> | <i>Hackeries.</i> |
| Average for 6 weeks ending 26th July, 1849,  | 371               | 256               |
| Average for 4 weeks ending 15th April, 1850, | 532               | 888               |
| Mean weekly Average, ...                     | 435               | 509               |

Assuming the above numbers to be the weekly average for the year, we have an annual total of 49,088 hackeries, and reckoning each to carry half a ton, we get a traffic of 24,544 tons, which at  $1\frac{1}{2}d.$  per ton would produce £17,794 per annum.

DAK TRAVELLERS.—These average about 408 per annum; they at present pay rupees 50 for the whole distance, and admitting that their numbers would be increased in the proportion that the charges are reduced, they would produce £2,040 per annum.

BANGY PARCELS.—£700 per annum.

TROOPS AND TREASURE—Would doubtless use the line, but the probable returns therefrom I have no means at hand to estimate from.

MISCELLANEOUS PASSENGERS.—These would doubtless be very considerable if the charges be low. Some notion of the numbers of travellers using the Trunk Road may be gathered from the following statement drawn up by Captain G. Thompson, late of the Bengal Engineers, of the numbers crossing Allahabad Bridge during eleven months, from the reports of a party stationed on the bridge for the express purpose. But as the bridge in question is very far beyond the limits of our experimental Railroad, (being within 33 miles of Benares,) the numbers cannot be adopted for this end of the road; yet it goes far to show, in the absence of better data, a probability that this source of traffic will not be inconsiderable :—

|                             |     |     |     |     |     |     |          |
|-----------------------------|-----|-----|-----|-----|-----|-----|----------|
| Foot passengers,...         | ... | ... | ... | ... | ... | ... | 4,35,242 |
| Passengers on horseback,    | ... | ... | ... | ... | ... | ... | 19,869   |
| Ditto in bullock carriages, | ... | ... | ... | ... | ... | ... | 9,314    |
| Ditto in horse ditto,       | ... | ... | ... | ... | ... | ... | 1,273    |
| Ditto on elephants,         | ... | ... | ... | ... | ... | ... | 247      |
| Ditto on camels,            | ... | ... | ... | ... | ... | ... | 389      |
| Ditto in palanquins,...     | ... | ... | ... | ... | ... | ... | 823      |
| Ditto in doolies,           | ... | ... | ... | ... | ... | ... | 1,265    |
| Total in 11 months,         | ... | ... | ... | ... | ... | ... | 4,68,422 |

66. Omitting those of the foregoing items to which I have not affixed a return, we have a revenue within reasonable limits of certainty as follows:—

|                             | £      |
|-----------------------------|--------|
| Coals, ... ..               | 44,136 |
| Salt,... ..                 | 11,185 |
| Miscellaneous goods, ... .. | 17,794 |
| Dâk travellers, ... ..      | 2,040  |
| Bangy parcels, ... ..       | 700    |

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Total per annum not less than ... .. £75,855

In giving the above numbers as so much of the expected traffic that is to be compared with similar traffic on the route towards Rajmehal, I must not be understood to have gone into the subject with any degree of minuteness, but have merely taken the most obvious sources of income, they being sufficient for my present purpose; but I feel convinced that were the subject gone into minutely, very many more sources of income would appear, which would swell the sum-total considerably.

PROBABLE TRAFFIC ON THE ROUTE TOWARDS RAJMEHAL.—67. After the above catalogue of probable traffic upon the *direct* route, I am surprised to find that there is nothing at all comparable therewith to advance on behalf of the route towards Rajmehal. The country which this line would traverse is chiefly grain-producing, similar to the other. Indeed, a large portion of both lines traverse the same district, and consequently their products will be about equal, and therefore it will be sufficiently accurate in this comparative inquiry to omit the probable traffic in local produce altogether from consideration upon both lines.

68. The making of this omission, however, is giving an undue advantage in favor of the route towards Rajmehal, because it implies that the present means of sending the produce to the Calcutta market is also equal upon both routes, which is by no means the fact, because the route towards Rajmehal *has*, and *will continue* to have, the benefit of a free river navigation, the Bhageeruttee and the Hooghly, which is the great commercial highway of the neighbouring districts, and will prove a very formidable rival to a Railway parallel thereto, and most likely would continue to carry the larger portion of the traffic of the district, the difficulties of the river lying beyond the limits of the Railroad.

69. The country being so well served by the river navigation, there is really little or no local traffic, salt included, and none that I am

aware of passing through to distant provinces can be safely reckoned to come upon the Railroad so long as it falls short of Rajmehal, which it can never reach with the present capital, and if that were enlarged for such a purpose, a new comparison between the two lines as to their cost and traffic must be entered upon, as the increased capital would give the means of extending the line on the direct route also. Under these circumstances, to follow the same order as in paragraph 65 in recording the expected traffic, would appear too much like levity for a grave matter of business; the expected traffic would appear so very trifling,—in short no traffic can be expected on this route unless it infringes on the Ganges.

70. Upon the whole, therefore, it would appear most advantageous to expend the million Sterling on the *direct* route, either wholly single, or partly double and partly single, as above stated; and if it should be deemed desirable hereafter to construct the line to Rajmehal, either for the purpose of relieving the Ganges traffic at that point, or with a view to its extension along the valley of the river to the North-West instead of prolonging the *direct* line, such a Railway could diverge from the Burdwan line; and as that portion of the latter line beyond the junction of the Rajmehal line would benefit the Coal district, no portion of the outlay would be expended in vain,—whether the whole line to the North-Western Provinces be ultimately taken *direct*, or by the circuitous route of the valley of the Ganges.

71. But before the question named at the close of the last paragraph can be settled, namely, as to the ultimate route of the whole line to the North-Western Provinces, much previous inquiry must be set on foot, correct surveys and estimates must be made, and correct statistics obtained. Amongst other sources of information, I would call attention to the valuable labours of Dr. McClelland, in his Geological Survey of the valley of the Barrakur, and adjacent country, in the season of 1849, through which district the *direct* route would take.

#### ANOTHER SITE FOR THE EXPERIMENTAL LINE OF RAILWAY POINTED OUT.

72. In the 35th, 36th and 37th paragraphs of my “Report on the River Ganges” addressed to the Government of the North-Western Provinces, dated 26th of May, 1846, I pointed out a direction for an experimental line of Railway as follows:—

“35. \* \* \* I will add a remark on the propriety of incurring any “large outlay in removing the difficulties of the navigation of the upper

“part of the river, with the probability that exists of an early commencement of the Railroad in the vicinity of Allahabad. In the report upon Railways lately delivered to the Government of India, it is recommended that the line from Calcutta to Delhi should pass through Sasseram, Chunar, Mirzapore, and Allahabad, with a branch line diverging from about nine miles South-East of Chunar to Raj Ghât, opposite to Benares, a distance of about 17 miles.

“36. Under such circumstances, the advisability of incurring so large an outlay as would be necessary for the improvement of the river between Benares and Allahabad appears to be doubtful, because a convenient landing-place, erected at Raj Ghât, and adjoining the Railway terminus, would obviate the necessity for the steam-boats proceeding higher than Benares during the dry season: if however it be desirable that they should proceed further up, a similar landing-place might be constructed at Chunar, as the difficulties of the navigation between Benares and Chunar are at present confined to the first three or four miles downwards from the latter place, and scarcely extend below Sultanpore.”

“37. It would therefore appear desirable that the works of the Railway between Benares and Allahabad, or Chunar and Allahabad, should be amongst the earliest that are commenced, and I feel myself warranted in advising both the Government and the Railway Company to that effect, as being best calculated to promote their mutual and the public interests.”

73. Such a Railway would prevent the necessity for any of the steam-vessels ascending the river higher than the lower terminus, and thus the tortuous and difficult channels of the river between Mirzapore and Allahabad, or Chunar and Allahabad as the case might be, would be avoided, for all the difficulties of the Ganges below Allahabad, with the exception of the Bulleah Flats, lie above Benares, or rather Sultanpore; these difficulties frequently prevent the Steamers reaching Allahabad at all, during a considerable period of the year.

74. A Railway connecting Allahabad and Chunar, and extended to Raj Ghât opposite Benares, if the capital would admit of it, would be very useful to the internal trade of the country, and would form an important portion of a main-line hereafter to be constructed from Calcutta, by either the *direct* or *river* route, to the North-West of India, and it would be a preferable site for such a purpose than from Allahabad in the direction of Cawnpore, because it would remove the detention

to trade occasioned by the shoals of the river, and also the requisite fuel for working the line would be more readily attainable.

75. The length of a Railway from Allahabad to Mirzapore would be about 54 miles, and if extended to Chunar, would be about 21 miles additional. The distances by the tortuous course of the Ganges are 86 miles and 32 miles respectively, or between Chunar and Allahabad,

By the proposed Railway, .. .. 75 miles.

By the River Ganges, .. .. 118 „

76. The determination, however, of the home authorities that the experimental line shall commence at, or near to, Calcutta, renders it unnecessary to enter further upon this subject than has already been done, namely, to point out the fact of the suitableness of such a site for an experimental Railway.

#### THE GOVERNMENT SUPERVISION AND CONTROL WITH SUGGESTIONS THEREON.

77. In the Despatch of the Hon'ble the Court of Directors of the 14th November, 1849, para. 2, we read,—“ It has been deemed necessary in the arrangement which has been entered into, to insist upon complete supervision and control by the East India Company of the Railway Companies and their officers, servants, and agents in all accounts, matters and affairs whatever, both during the construction of the Railway, and after it shall have been opened for the conveyance of passengers and goods.”

78. And upon the same subject, in paragraph 19, it is said,—“ We cannot, however, too strongly impress upon you our desire that the greatest efforts may be used in order that your officers may work in perfect harmony with the officers appointed by the Railway Company; such an harmonious co-operation appears to us to be essential for the success of the undertakings upon the principle which we have adopted.” The mode in which the power thus given to the East India Company can be best exercised in India is left by the Hon'ble Court to be determined by the Government of India.

79. Whatever hereafter may be the amount of labour in exercising such a supervision, it is quite certain that for a long time to come it will be but very little; neither do I think it will ever be of much magnitude whilst the capitals of the Railway Companies are so small as they now are. The business of such supervision will entirely require skill

and experience in the construction and management of Railways, and without that peculiar kind of knowledge, possessed only by the practised engineer, the intentions and wishes of the Court of Directors can never be fully carried out.

80. I am clearly of opinion that the most successful control and supervision will be exercised by leaving the whole business in the hands of one man, who should be held most fully and completely responsible for the whole business, and to this end he should be unfettered and uncontrolled by any colleagues whatever, and subject only to the Government of India, with whom he should be in direct communication.

81. The foregoing opinion is the result of experience ; and I am convinced that whenever a duty can be confined to one individual, it will be performed with much greater efficiency than it ever will be by dividing the responsibility amongst a Board or Committee of several ; for in addition to there being then no individual responsibility, a Committee seldom pull well together ; and differences (to say the least) will arise in the best regulated Boards, which greatly retard business, and in this case would compel continual reference and annoyance to Government, and also in a pecuniary view, Boards in this country are very costly modes of administration.

82. In the present instance, if the business of Government supervision of the Railways be managed by a Board, it is almost if not quite impossible that any of its members, except my successor in office whoever he may be (myself being on the eve of quitting India), can have had any practical experience in Railway matters, and most certainly none in Railway construction. Into the hands of my successor, therefore, I would most respectfully, and with due deference, recommend that the whole of the business be placed, and to him the whole and sole responsibility confided ; the Government will then know unmistakeably to whom to look if matters do not progress satisfactorily, and whom to honor whenever honor may be due. His necessary establishment for some time to come need only be small and inexpensive, and would consist of an accountant and some native writers, which could be increased as his necessities required. Let him annually visit Bombay ; the journeying would be good for his health, and the apparent delay caused by the transmission of letters can be of no moment whatever in such business as we are now considering.

83. Whatever may be the value of my opinion upon this point, it at least must have the merit of being disinterested, as I am about to

quit India for ever, and therefore shall have nothing to do with the supervision of the Railway Company's proceedings ; neither do I know who my successor in office is likely to be ; but be he who he may, I doubt not that, like myself, he would infinitely prefer having the whole of the responsibility than that it be divided between himself and others, for a divided responsibility to my mind is extremely distasteful, and would assuredly fail of that full measure of success which it would be the pride of *one* person to attain ; and as all the disgrace would fall upon him in the event of failure, so would all the honour be his own upon his attainment of that success which his unfettered energies would be the most likely to realize.

#### SUMMARY OF THE RECOMMENDATIONS MADE IN THIS REPORT.

84. In conclusion, I will recapitulate the recommendations given in the preceding pages :—

*First*,—That Howrah be selected as the site for the Calcutta terminus ; paras. 18 to 28.

*Second*,—That the breadth of guage for the Railways in India be 5 feet 6 inches ; paras. 29 to 35.

*Third*,—That rails of 84 lbs. to the yard be adopted, and the Permanent Way be very substantial ; paras. 36 to 42.

*Fourth*,—That the experimental line should take the direct route towards the North-West, and that it be wholly single, or partly a single and partly a double line ; paras. 50 to 71.

*Fifth*, A recommendation as to the mode of administering the Government supervision ; paras. 77 to 83.

An outline plan, showing the routes discussed in the preceding paras. is attached to the Report.

I have the honor to be &c.,

(Signed) F. W. SIMMS, C. E.,

*Consulting Engineer to the*

*Government of India, and Director*

*of the Railway Department.*



POSTSCRIPT.—Since the preceding Report was written, I have seen the Report of Mr. R. M. Stephenson, the Managing Director of the Railway Company, published in 1845, where in Appendix 37, is a letter from Captain Anderson, of the Bengal Engineers, to his address, dated 4th September, 1844, communicating *facts* relative to the goods-traffic between Calcutta and Burdwan.

Also I have seen for the first time a printed copy of a letter from Mr. Stephenson to the Secretary of his Company, dated "Calcutta, 11th March, 1848," which contains an abstract Table of the traffic on the Trunk Road, prepared from statements made by Major Willis, of the Bengal Engineers, and other Officers in the Government Service.

These documents confirm the statements given in paragraph 65 of the preceding report, and I have subjoined, as follows, an extract of Captain Anderson's letter, containing his information respecting the traffic: and of the second letter, I subjoin the said abstract Table—

EXTRACT FROM CAPTAIN ANDERSON'S LETTER.—"As to whether the  
 "Railway will be remunerative or otherwise, I fear I am not competent  
 "to give an opinion, but I think a single rail from Calcutta to the  
 "Coal-mines, passing Burdwan, would give an ample remuneration  
 "on the outlay, supposing the traffic to remain as at present. The  
 "distance from Calcutta to the first Coal-mine on the line of the  
 "present Benares road is 125 miles, and for fifteen miles further  
 "the road passes over the Coal-field; the line of Railway would  
 "therefore be 140 miles. In the accompanying Table, I have given a  
 "statement of the number of carts and bullocks that passed one spot  
 "of the road between Burdwan and Muggra monthly for nineteen  
 "months; but I must remark that it is the general practice in  
 "this country for natives to travel with their carts in the night-  
 "time, and that it is my opinion that the Table, from containing  
 "only those that pass in the day-time, does not contain one-half  
 "the number of carts, &c., that actually pass over the road. I  
 "have added to the Table a few calculations, showing the weight  
 "of goods carried (principally sugar, cloth and thread), but I have only  
 "allowed one-third more for carts passing in the night-time. I have  
 "also made a calculation at assumed rates of the probable out-turn.  
 "The rate of five rupees per ton would, I am led to believe, be willingly  
 "paid for coals from the mines to Calcutta. At present in favorable  
 "seasons for transporting coals by the Damooda River to Calcutta, the  
 "quantity so taken would be about 200,000 maunds, or 74,064 tons. In

“the calculation I have taken this as the quantity, but I have no doubt  
 “that were there a Railway, double that quantity would be conveyed  
 “yearly. At the rate I have assumed, there is another article that  
 “would be carried in great quantities, namely, charcoal. It could be  
 “procured at from ten to fifteen rupees per 100 maunds, near the 110th  
 “milestone, and the carriage by the Railway would be about eighteen  
 “rupees, in all, landed in Calcutta, thirty-one rupees, where it frequent-  
 “ly sells as high as seventy-five rupees per 100 maunds. Indeed, I have  
 “no doubt that many other articles of traffic would be found that are  
 “at present unthought of. I have made a hurried tracing of the  
 “country from Calcutta to the Coal-mines in pencil (the paper will not  
 “take ink), which may assist you in understanding the localities to  
 “which I allude.”

*Statement of the number of Carts passing along the Road between Burdwan  
 and Muggra.*

| Months.           | Carts laden<br>to Burdwan. | Carts empty<br>to Burdwan. | Carts laden<br>to Calcutta. | Carts un-<br>laden to Cal-<br>cutta. | Bullocks to<br>Burdwan. | Bullocks to<br>Calcutta. | Number of<br>days. |
|-------------------|----------------------------|----------------------------|-----------------------------|--------------------------------------|-------------------------|--------------------------|--------------------|
| 1842.             |                            |                            |                             |                                      |                         |                          |                    |
| December, ...     | 1745                       | 287                        | 1471                        | 306                                  | 572                     | 1568                     | 31                 |
| 1843.             |                            |                            |                             |                                      |                         |                          |                    |
| January, .....    | 1806                       | 202                        | 1954                        | 296                                  | 634                     | 2076                     | 31                 |
| February, ...     | 4660                       | 2364                       | 2252                        | 1618                                 | 1840                    | 2432                     | 28                 |
| March, .....      | 3987                       | 4496                       | 5818                        | 4218                                 | 1422                    | 6034                     | 31                 |
| April, ... ..     | .....                      | .....                      | .....                       | .....                                | .....                   | .....                    | .....              |
| May, ... ..       | 1171                       | 1165                       | 956                         | 1340                                 | 951                     | 904                      | 21                 |
| June, ... ..      | 1168                       | 279                        | 957                         | 257                                  | 3034                    | 3605                     | 30                 |
| July, ... ..      | 1385                       | 240                        | 1614                        | 281                                  | 2647                    | 3236                     | 31                 |
| August, ... ..    | 1008                       | 216                        | 1021                        | 344                                  | 1896                    | 2355                     | 31                 |
| September, .....  | 1416                       | 330                        | 1165                        | 655                                  | 2608                    | 2495                     | 30                 |
| October, ... ..   | 1698                       | 307                        | 2079                        | 560                                  | 2104                    | 3153                     | 31                 |
| November, .....   | 2507                       | 248                        | 1855                        | 435                                  | 2481                    | 2663                     | 30                 |
| December, ...     | 2519                       | 447                        | 2550                        | 447                                  | 2747                    | 3165                     | 31                 |
| 1844.             |                            |                            |                             |                                      |                         |                          |                    |
| January, .....    | 2397                       | 503                        | 2349                        | 403                                  | 2528                    | 3110                     | 31                 |
| February, ...     | 2947                       | 602                        | 3199                        | 582                                  | 2914                    | 3430                     | 29                 |
| March, ... ..     | 2739                       | 370                        | 2983                        | 419                                  | 3109                    | 3123                     | 31                 |
| April, ... ..     | 2745                       | 313                        | 3040                        | 326                                  | 3163                    | 3296                     | 30                 |
| May, ... ..       | 2913                       | 237                        | 2870                        | 226                                  | 3085                    | 3076                     | 31                 |
| June, ... ..      | 2745                       | 188                        | 2792                        | 173                                  | 2804                    | 2924                     | 30                 |
| July, ... ..      | 2834                       | 242                        | 2876                        | 214                                  | 2907                    | 3072                     | 31                 |
| Total, .....      | 44390                      | 14036                      | 43801                       | 13123                                | 43446                   | 55717                    | 579                |
| Daily average, .. | 76 $\frac{2}{3}$           | 24-24                      | 75-65                       | 22-66                                | 65-1                    | 96-23                    | .....              |

## PROBABLE WEIGHT OF GOODS TRANSPORTED DAILY.

|                                                                      | <i>Carts. Mds.</i> |                                              | <i>Tons.</i>     |
|----------------------------------------------------------------------|--------------------|----------------------------------------------|------------------|
| To Burdwan from Calcutta, .....                                      | 76                 | $66 + 12 = 919.99$ , or about ...            | 34               |
|                                                                      | <i>Bullocks.</i>   |                                              |                  |
| "                    "                                               | 75                 | $1 \frac{1}{2} = 112.5$ , or about ...       | $0 \frac{4}{8}$  |
| To Calcutta, from Burdwan, .....                                     | 75                 | $65 + 12 = 906.6$ , or about ...             | $33 \frac{1}{2}$ |
| "                    "                                               | 96                 | $23 + 1 \frac{1}{2} = 144.34$ , or about ... | $5 \frac{1}{4}$  |
|                                                                      |                    |                                              | 38 $\frac{3}{4}$ |
|                                                                      |                    |                                              | <hr/>            |
|                                                                      |                    |                                              | 68 $\frac{3}{4}$ |
| Add one-third for carts and bullocks that pass at night, say, ... .. |                    |                                              | 22 $\frac{1}{4}$ |
|                                                                      |                    |                                              | <hr/>            |
|                                                                      |                    |                                              | 91               |
| Coals from mines, $74,074 \div 365$ , about ... ..                   |                    |                                              | 203              |
|                                                                      |                    |                                              | <hr/>            |
| Daily Tonnage, ... ..                                                |                    |                                              | 294              |

" After writing the above, I saw the post-master of this place, who  
 " has kindly given me the following items of traffic between Burdwan  
 " and Sherghottee, 216 miles, *viz.*,

|                                                           |            |
|-----------------------------------------------------------|------------|
| " Amount paid for 339 palanquin dâks, ... ..              | Rs. 26,448 |
| "      "      for carriage of mail and bangy parcels, ... | 47,568     |
| " Extra, ... ..                                           | 3,095      |
|                                                           | <hr/>      |
| " Total per annum for 216 miles, ... ..                   | Rs. 77,111 |

" I have avoided all mention of a Railroad beyond the Coal-mines,  
 " as I am not acquainted with the country through which it would pass,  
 " or with the traffic there would probably be on its completion. In-  
 " formation on these points, I have no doubt, you will be able to get  
 " from other and better sources.

" Wishing every success to your project, believe me,

" My dear Mr. Stephenson,

" Your's truly,

(Sd.) " J. ANDERSON."

*Abstract Table of traffic on the Trunk Road from the Statements of  
Major Willis and other officers.*

| Passengers.                | Half Year. | One Year. | Cost per Mile<br>in pence. | Average Dis-<br>tance travel-<br>led Miles. | Cost each.   | Total.   |
|----------------------------|------------|-----------|----------------------------|---------------------------------------------|--------------|----------|
|                            |            |           |                            |                                             | <i>s. d.</i> | <i>£</i> |
| On foot, ... ..            | 3,31,822   | 6,63,644  | 0.532                      | 89                                          | 3 9          | 1,24,433 |
| Horseback, ... ..          | 10,341     | 20,682    | 1.12                       | .....                                       | 8 4          | 8,617    |
| Carts, ekhahs, ... ..      | 7,053      | 14,106    | 1.5                        | .....                                       | 11 1½        | 7,846    |
| Pilgrims, ... ..           | 88,885     | 1,77,770  | 0.533                      | .....                                       | 3 9          | 33,331   |
| Troops, ... ..             | 11,778     | 23,556    | 0.533                      | .....                                       | 3 9          | 4,416    |
| Camp-followers, .....      | 7,823      | 15,646    | 0.25                       | .....                                       | 1 10¼        | 1,466    |
| Daks, ... ..               | 1,622      | 3,244     | 12                         | .....                                       | 89 0         | 14,436   |
| Travellers' Palanquins ... | 494        | 988       | 8                          | .....                                       | 58 4         | 2,881    |
| Boxwallahs, ... ..         | 174        | 348       | 0.533                      | .....                                       | 3 9          | 68       |
| Letter-carriers, ... ..    | 3,624      | 7,248     | 0.533                      | .....                                       | 3 9          | 1,359    |
| Buggies, ... ..            | 65         | 130       | 0.3                        | .....                                       | 22 3         | 141      |
| Dak Doolies, ... ..        | 303        | 606       | 8.0                        | .....                                       | 58 4         | 1,767    |
| Total, ... ..              | 4,63,984   | 9,27,968  | .....                      | .....                                       | .....        | 2,00,765 |

| For Goods.                                | No.      | No.      | Tons.  | Load.                                     | Maunds. |            |
|-------------------------------------------|----------|----------|--------|-------------------------------------------|---------|------------|
| Bullocks laden, ... ..                    | 24,026   | 48,052   | 3,559  | .....                                     | 2       |            |
| Ditto unladen, .....                      | 21,025   | 42,050   | .....  | .....                                     | .....   |            |
| Camels laden, ... ..                      | 1,597    | 3,194    | 473    | .....                                     | 4       |            |
| Ditto unladen, .....                      | 562      | 1,124    | .....  | .....                                     | .....   |            |
| Hackeries laden, ... ..                   | 37,841   | 75,682   | 28,030 | .....                                     | 10      |            |
| Ditto empty, .....                        | 16,310   | 32,620   | .....  | .....                                     | .....   |            |
| Horses, Government }<br>or sale, ... .. } | .....    | .....    | .....  | .....                                     | .....   |            |
| Laden coolies, ... ..                     | 7,727    | 15,454   | 572    | .....                                     | 1       |            |
| Elephants, ... ..                         | 91       | 182      | 33     | .....                                     | 5       |            |
| Laden horses, ... ..                      | 2,610    | 5,224    | 423    | .....                                     | 2       |            |
| Banghies, ... ..                          | 1,991    | 3,982    | 442    | .....                                     | 3       |            |
| Horses unladen, ... ..                    | 631      | 1,262    | .....  | .....                                     | .....   |            |
| Empty buggies, .....                      | 82       | 164      | .....  | .....                                     | .....   |            |
|                                           | 1,14,493 | 2,28,986 | 33,532 | { Tons at 4d. per<br>mile for 80 miles, } |         | 44,512     |
|                                           |          |          |        |                                           |         | £ 2,45,277 |
| 74,000 Tons of Coal at 10s.,              |          |          |        |                                           |         | 37,000     |
|                                           |          |          |        |                                           |         | £ 2,82,277 |

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FROM MAJOR J. P. KENNEDY.

*Consulting Engineer to the Government of India,  
Railway Department.*

TO F. J. HALLIDAY, Esq.,

*Secy. to the Government of India,  
Home Department.*

DATED FORT WILLIAM, THE 29TH JANUARY, 1851.

SIR,

I HAVE just returned from perambulating the East Indian Railway Company's line from Howrah to Pundowah, in company with the Chief Engineer of that Railway, whilst he was engaged in the important operation of fixing the sites and dimensions of all bridges and other openings required on the line for the drainage, convenience, and security of the neighbourhood and of the works.

2. The valuation Commissioner has given over possession to the East Indian Railway Company's officers of the land contained in plans No. 1 and No. 2, the first that were sanctioned by the Government, so that the execution of the works may now be said to have fairly commenced.

3. Under these circumstances I think it right to offer for the consideration of Government the result of my observations on several points connected with the future progress of these particular operations, but in doing this, there is much that I shall have to say which will refer to broad principles applicable to Railway operations generally throughout India.

4. I am persuaded that the most effectual mode of ensuring an efficient and economical application of funds in the construction of engineering operations is that of bringing under the frequent periodical revision of the controlling authority an abstract view of the total expenditure incurred, together with the corresponding progress effected in the work, and the consideration of all matters affecting its interests.

I am anxious therefore at once to establish this principle at monthly intervals, and accordingly I beg now to offer the first Monthly Progress Report of the operations under the East Indian Railway Company, consisting of an abstract of the outlay from the commencement, as furnished by the Accountant's Department, and an abstract of the work effected, as furnished by the Engineering Department, showing the whole of

the expenditure and the corresponding work done from the commencement of the enterprize to the 31st of December last.

5. I entirely approve of the system pursued by the East Indian Railway Company, under which the quantities, description, and locality of the works executed are verified and sent into the Calcutta office, with the agreed rate of payment and amount specified by the Chief Engineer. These accounts are examined and posted under their respective headings by the accountant or book-keeper in a distinct department, and after an indent has been submitted to and sanctioned by the Government for their payment, they are severally entered in a monthly pay bill and cheques passed, under the several signatures of the Railway Company's Agent, the Chief Engineer, and the Chief Clerk or Secretary, no payments whatever being made except under these conditions. I cannot too strongly recommend the continuance and invariable application of the principles above defined.

5½. It is desirable that full information on all subjects connected with the Railway operations should be recorded, and available at the chief office of the Company in Calcutta. Complete copies of all documents, reports, specifications, books of account, and of contract work, with copies or tracings of all designs, plans, sections, and working drawings, in addition to the returns of expenditure and work executed, should be transmitted monthly for this purpose from the several departments of the chief resident and district engineers, the traffic manager (hereafter), the locomotive repairing establishment, the store-keeper's cokeing ovens, and from every department of the Railway. This is indispensable, and much depends upon its due and regular observance.

5½. The correspondence is very properly separated from the engineering duties, and it is desirable that in all correspondence between the Government and the Railway Company, the views of the Railway Directors in this respect should be scrupulously observed, and that no communication should take place between the Government and the Railway Company except through the accredited organs, all correspondence being carried on between the Government representative, and the Agent of the Railway Company exclusively, and without exception.

5¾. It has also been prudently provided that no appointments of any kind shall be made until after an investigation by the Company's Agent (and Chief Engineer, when in his department,) into the respective

qualifications of the several parties upon which to determine the amount of salaries recommended for sanction by the Government.

6. I would recommend that the Monthly Progress Reports and Abstracts made up to the end of each month should be sent in by the Railway officer on or before the 15th of the following month. This would give sufficient time for getting in all returns from out-stations as well as for posting and making up the accounts and abstracts.

7. I beg to recommend for approval and sanction of Government the general adoption of the accompanying form of an analytic record, which embraces in classified detail all the operations of construction, working, income and expenditure of a line of Railway (see Appendix No. 7). These forms have been carefully arranged by Mr. Stephenson, the Agent of the East Indian Railway Company, and apply as well to the permanent working of the line as to its first construction.

8. As soon as the Government shall have received the monthly accounts, sustained by vouchers, *as in Europe*, with the Consulting Engineer's observations upon them, the accounts might then be immediately placed in the hands of the Auditor to receive the final examination instead of having that final audit deferred to the end of the half-year as at present.

9. And no expenditure should be passed by the Auditor, except under urgent circumstances, which had not received the previous sanction of Government in some monthly, or general, indent or estimate.

10. I know from experience that the system will have the effect of introducing method and regularity into the whole of the proceedings. It will prevent much miscellaneous correspondence. It will be most useful by bringing under the frequent consideration of the Chief Engineer of the Railway Company a comprehensive view of his own progress, both as regards time and rates of expenditure, and it will furnish to the Government and to the Directors and Shareholders of the Company that timely knowledge which is the only useful knowledge in the control of the expenditure and in reference to the power of averting evil.

When the money is all gone, it is of very little use to find out that it has gone without producing commensurate results, and hence final accounts in such cases are of no other avail than to inform the sufferers of their irreparable loss; whilst that loss might have been averted by the early and frequent rendering of accounts with reports, bringing forward for careful discussion all future operations which may

require further consideration. And I cannot shut my eyes to the fact that there are intricate and difficult elements for consideration connected with points which have been already decided, contracts having been entered into before I took charge of my present office for the execution of works to which those considerations would refer.

11. It was with much anxiety that I learned the decision of the Directors of the East Indian Railway Company and of the Hon'ble Court, requiring that the Experimental Railway Works should be commenced in the low country of Bengal, because I felt assured that much previous consideration and some preliminary outlay would be required in dealing with the very difficult questions connected with the periodical inundations here, both as regards the permanent security of the works and their first cost.

12. That point, however, having been decided, it now only remains to use the best precautions to avert the most distinct and formidable danger to which the works may be exposed. That danger unquestionably arises,—*first*, from the ordinary inundations that take place in the flat country between the rivers Hooghly and Damooda; and *secondly*, from the extraordinary and more alarming inundations in the same district, produced by the river Damooda occasionally bursting its embankments.

I should be extremely sorry to convey any idea, that I imagined the works which have been undertaken to be impracticable, or even very difficult. All that I maintain is, that they require the most careful forethought fully to provide against those dangerous contingencies to which they must be exposed, if those contingencies are not in the first place considered and provided against.

I believe that they can be so counteracted, but I do not find that either the Directors of the Railway Company, or the Government have yet been furnished with such specific data as are essential to the projection of a sound method by which the inundations referred to may be controlled, or directed in their course, so as to *diminish* or regulate their *accumulation and velocity*, whilst we stimulate their final discharge. Of two facts, however, there is a certainty,—*first*, that the water-way by the ordinary channels is insufficient to contain the floods; *secondly*, that the artificial embankments resorted to are miserably deficient, whether as regards the width of channel they are intended to enclose, or the section of the enclosing banks. These structures, averaging several feet in height, are made generally but three feet wide at the top, with slopes

of 2 and 3 to 1. They must necessarily yield before the velocity of the floods to which they are opposed; and the Superintending Engineer of the South-Eastern Provinces has furnished returns which show that 10,040 breaches occurred in the embankments of his circle in one year, 1845-6; that in ten years, from 1835-6 to 1844-5, the embankments in his circle cost 19,73,558 rupees, besides remissions paid to zemindars in the same period, amounting to 14,77,891 rupees. This would make the cost of construction and repairs of embankments average very nearly two lakhs per annum, and the remission of revenue nearly one and a half lakh per annum.

The section for embankments intended to resist the Bengal floods should not be less than 10 feet at top, with slopes of 5 to 1, and they should be placed sufficiently far apart to afford ample water-way for the largest floods.

The cost of constructing both banks of the insufficient dimensions may probably be averaged at about £68 per mile of river, and when done they are of comparatively little use, although they entail heavy annual charges.

The cost of constructing banks of strong dimensions, and further apart, may be considered £154 per mile of river. This improvement would likewise require the shutting out of additional portions of land (from 40 to 80 acres per mile) to a very considerable extent, but it is probable that a slight remission of rent would remunerate the zemindars for the additional risk to crops growing on the land so excluded, as it is generally considered that the river banks give the best crops, although the risk to the crop outside the embankment is very great in years of high floods.

13. There are many resources which may be brought in aid to meet the inconveniences that threaten the works from inundation. The Damooda embankments may be strengthened and placed further apart as suggested; assistant conduits for its waters may be opened to the Westward of the great turn in that river near Burdwan, as well as conduits regulating the direction and facilitating the discharge of the inundation in the low ground between it and the Hooghly; small crop bunds may be made to reduce the velocity of the water in given places between those rivers, and a variety of other means may be put in practice as defences against the effects of an ungoverned flood. But I am of opinion that those measures ought to be distinctly specified and commenced with the least possible delay.

14. The line of the Railway is close along the right bank of the Hooghly. From Howrah to Pundowah, the authorized portion for 40 miles lies nearly parallel to, and at an average distance of about 23 miles from its greatest enemy—the Damooda river. . There is at present, as far as we are aware, no danger to be apprehended from the Hooghly. There is a general fall from opposite Pundowah to the Southward through the district between the rivers. There is also a fall from each river bank in the transverse direction towards some intermediate line between them ; but the precise degree of fall in each direction, and the course of the lowest intermediate line require to be accurately defined.

15. In reference to the foregoing state of things the question arises as to the best means of directing and facilitating the discharge of the waters from the district, and whether that should be by improving the old course of the Damooda as well as the new course, and by cutting through the lowest line from North to South, a channel which should void itself into the Hooghly at its bend near the Midnapore road, as well as at a point near Sancrail. The general interests of the district, irrespective of the Railway, appear to require that this important subject should be deliberately considered.

16. The cost of the works at present proposed on the 40 miles of sanctioned line for bridges, conduits, &c., connected with the drainage, will be from £30,000 to £40,000.

This might have been for the greater part saved if the general question as regards the wants of the district in respect to the inundations were better regulated.

17. I earnestly hope that the Government will see the necessity of recommending that most distinct measures should be adopted in the Surveyor General's Department for collecting and condensing all the requisite information affecting the broad and vital questions of inundations in Bengal, considering carefully the subject of alluvial deposits, and the incessant changes that are taking place in consequence both in the surface of its land, in its rivers and in its bay. I need only refer to the well-known state of Lower Bengal for a great portion of the year whilst the inundations continue, and to the fact of the beds of the rivers in many places being higher than the surface of the neighbouring lands, as well as to the fact ascertained by experiment, that as much as two cubic inches of soil per cubic foot of water has been found to exist in suspension flowing over the surface.

18. Assuredly the time has come when this important subject

should receive the earnest consideration of Government. I feel confident that the present perilous and uncontrolled progress of the Bengal inundations can be regulated and turned to good ; we may be convinced of this from the example afforded in the Florentine state, wherein little judgment and science have converted the devastation and insalubrity of ungoverned floods into a healthful and fertilizing principle, by the adoption of a very simple and inexpensive process which brings them within control.

19. As the violence and evils produced by floods are proportioned to their velocity caused by the concentration of the waters, so the mode by which they are to be rendered harmless must depend upon the dispersion of the waters and the prevention of their acquiring any considerable velocity. If the waters of the Damooda from their source be forced by level steps on contour lines to present a front of several miles instead of being restricted to a few hundred feet of front, they could not acquire either force or velocity. The level steps would be formed by very small raised banks, seldom exceeding a foot or two in height, such as we find in rice-field irrigation, but stronger. These where they are placed would cause still water, and thereby permit the deposit of the substances with which the water is charged. The effect of this would be gradually to raise marshy or low lands by the deposit left upon them, but it would be very disastrous to do away with the existing bunds, as some parties have recommended, before the new level beds had been laid out and constructed ; on the contrary, all such bunds should be carefully preserved until the principle proposed to supersede their necessity is perfected and practically tested.

The Agent and Chief Engineer of the East Indian Railway Company, Messrs. Stephenson and Turnbull, probably felt themselves limited when bringing forward their project to dealing with the state of the district and its inundations as they found them. But I feel justified in suggesting to the Government the propriety of directing the attention of the Railway Company's officers, as well as of the Surveyor General's Department, and the Public Works' Department of the several districts to the broader consideration of how the inundations might possibly be controlled and directed in such a way as may be at once beneficial to the general interests of the district, and to the security and permanence of the Railway Works.

20. The Minute of the Most Noble the Marquis of Dalhousie, dated the 4th of July, 1850, sanctions the construction of the Experimental



Line of Railway between Howrah and Pundowah with earth-works and masonry for a double line of rails. It likewise recommends that the Hon'ble Court should so far alter their decision as to permit for the present the laying down of only a single track upon this portion, and it further recommends an extension of this line from Pundowah to the Collieries at Raneegunge by means of a single track, in every respect, earth-work, masonry and rails, enclosing, however, the land required for running a double line subsequently. His Lordship's arguments in support of these recommendations are most conclusive and unanswerable.

21. But the Government have not been furnished with any data upon which to ground a decision as to the further extension of the lines beyond the Collieries.

22. My predecessor, in his last report, dated 29th April, 1850, abstains from giving a decided opinion as to which of the disputed directions, that by the Sherghottee hills or that by the Ganges river, should be subsequently adopted as the line of the road towards its destination in the North-West Provinces. Mr. Simms offers as a reason for withholding the expression of a decided opinion upon this very important question, the fact, that he had only examined one-third of the river line.

23. Other influential persons appear to have given opinions favorable to the barren mountainous lines and hostile to the level productive lines. Their arguments, however, do not appear satisfactory, as all reference is omitted to those points which I conceive should decide the whole question.

24. These omissions I shall seek to supply, as I feel that the quick settlement of this question on sound grounds is essential to the systematic progress of the undertaking generally, as well as to the character for prudential forethought and energy of all those who are concerned in its control, superintendence or direction.

25. For these reasons I shall make every exertion to examine generally the Ganges line before leaving India, as the working year here for such an examination is by most persons restricted to about five or six months, and if I allow this cold season to pass without placing before Government the means of coming to a decision, the question will most probably remain in its present undecided and unsatisfactory state for another year.

26. I have twice seen the Sherghottee hill line, and lest my health should prevent my intention of visiting the Ganges line before I quit

India, I shall even now place before the Government such considerations connected with the known circumstances of the two lines as I am justified in doing, reserving my final opinion, as far as it is dependent on an actual view of the Ganges line, until after having visited that district; this course may avert fruitless arrangements and anticipations, or perhaps irretrievable errors.

27. The original project as it now stands, appears to be that a line of Railway should be formed from Calcutta to Delhi passing over the Sherghottee hills, and thence by Mirzapore—the latter place being 466 miles from Calcutta—throwing out one branch to Rajmehal, 140 miles in length, one to Patna 40 miles, and a third to Benares of 15 miles; the length of Railway thus required between Calcutta and Mirzapore including its branches would be 661 miles by the hill route.

28. The branches are no doubt a very important part of the project, as a means, although an imperfect means, of bringing upon the line the lower Ganges traffic.

29. The undulating land and hill district extend for about 200 miles; they would entail heavy cuttings and fillings, with quick inclines and curves. The old section shows a summit of 1,380 feet above Calcutta, and 1,040 feet above Mirzapore, with an aggregate rise towards Mirzapore of 2,044 feet, and an aggregate fall in the same direction of 1,804 feet, and a maximum incline for nearly 10 miles of 1 in 61 or 1 in 62; and although it is probable that a somewhat lower summit level may be selected, and that considerable improvements may be made in the gradients, still there is little doubt that the lowest summit to be found in that neighbourhood would be from 900 to 1,000 feet above the terminus at Calcutta, and from 600 to 700 feet above Mirzapore; so that after increasing the distance, say 16 miles, to obtain this advantage, severe gradients must still result, even supposing the practicability of reducing the maximum slope from 1 in 61 to 1 in 100.

30. The river district, on the contrary, offers a line where the whole difference of level is only 240 feet between Calcutta and Mirzapore, this rise being almost uniformly spread over a distance of nearly 600 miles, and where, consequently, the gradients may be made nearly uniform, averaging about 1 in 12,000.

31. There are probably more goods for transport, converging to the various points of the Ganges line between Mirzapore and Calcutta, than on any other line of equal length in India, all of which must swell the revenues of a judiciously-managed Railway, meaning a Railway in

which the selection of the line, its construction, and its after-working shall enable a company to charge the lowest possible freight. Between Raueegunge and Mirzapore, a distance of 320 miles of the hilly line, on the contrary, neither goods nor passengers converge, nor can the smallest portion of revenue reasonably be expected from that district; and what is still more unfavorable, not only will this long distance fail to produce revenue itself, but the 200 miles of hill district which it includes will render it absolutely impossible to carry the goods furnished by other productive places at low freights. Proofs of this last position as follow :

32. The maximum gradient on the hill line, I shall not take so unfavorably as now represented at 1 in 61, but shall assume it capable of being improved to 1 in 100 by increasing the distance 16 miles. The maximum gradient on the more level line I shall not take at anything near to its average of 1 in 12,000, although to reduce it as near as practicable to that, should be the *main* effort of any competent man charged with the construction; but I shall assume that the regulating gradient on the river line may be 1 in 2,000.

33. On well-laid level rails, the most accurate experiments that have been made with well-conditioned waggons justify the estimate of 6 lbs. per ton as the force required to overcome friction and maintain motion, exclusive of the resistance of the air; and in ascending inclines the force due to gravity on the particular incline must be added. This will give for friction and gravity together a tractive force of 7.12 lbs. per ton required on an ascending plane of 1 in 2,000, and a tractive force of 28.4 lbs. per ton required on an ascent of 1 in 100, to maintain motion.

34. The practical effect of this difference would probably be to cost the Railway Company as much engine power in carrying 1 ton along the hill line, with a regulating gradient of 1 in 100, as in carrying 4 tons along the river line, with the regulating gradient of 1 in 2,000. Because the probable course would be to adapt the load to the powers of the engine as calculated for the most difficult part of the line; or the most favorable mode by which the advocates of the hill line could recommend its adoption would be by saying that the load may be adapted to the minor slope of 1 in 2,000, and that assistant engines may be added to carry it over the 200 miles of hill district, three such assistant engines being required on part of the road. In addition to this must be calculated the engine power in operation, at the same

time in moving the three separate arrangements of trains on the three distinct branches of Benares, Patna, and Rajmehal.

35. Let A represent the cost per mile of conveying a ton of goods on the more level line, of which the regulating gradient is 1 in 2,000; and suppose the locomotive proportion of that cost to be as it is in some lines about  $\frac{1}{3}$  of the entire cost; then the locomotive cost on the hill line would be equal to  $\frac{1}{3}$  A, and on the hilly line  $\frac{1}{3}$  A, multiplied by 4 or  $1\frac{1}{3}$  A; and if all other circumstances were alike for each, the total cost for freight per ton would be,

On Hilly line, ... ..  $\frac{2}{3}$  A +  $1\frac{1}{3}$  A = 2 A.

On Ganges line, ... ..  $\frac{2}{3}$  A +  $\frac{1}{3}$  A = A.

or the total cost of transport would just be twice as much per ton on the hilly line as upon the line of the Ganges. But this is a most favorable view to take of the case as regards the hilly line; because when the road is such as to permit of a heavy load being carried by the engine, the locomotive expense could be brought much below one-third of the total expense of carrying per ton; and on the contrary, where the inclines or other causes limit materially the weight of the load, the locomotive expenses would rise proportionably above  $\frac{1}{3}$  of the total working cost per ton carried.

36. Having thus considered the general principle which must regulate the comparative rate of freights on the respective lines, and having got the scale by which the principle can be applied and measured as affecting each, it may now be well to enter into a general estimate, both for construction and working, that we may compare the original investment required for completing each line in the first place, and the smallest amount of traffic that shall secure a profitable return upon those investments respectively.

27. This latter point must be secured, otherwise utter failure must be the consequence; the only method by which it can be insured is that of *now* looking fully into the whole case, the ultimate working as well as the construction and regulating the expenditure from the *very outset* on a scale suited to that amount of traffic and consequent revenue which can be calculated on with a positive certainty. Now is the time that the future economical working of the line can be regulated and secured, and not after the works are made.

38. I have heard some say that the public do not expect the first portion of the line opened, say from Calcutta to the Collieries, to pay. There never was a greater error: whatever the public may profess to

expect, or not to expect, the only chance of capital being forthcoming for the subsequent extension of the line will rest on whether a fair dividend is paid *out of revenue* six months after it opens to the Collieries. *This and this alone* is the point to look to *by the engineer in charge, and by him alone it can be secured.*

39. If he now provides that the powers of his engines shall be left wholly available for the profitable labour of conveying the largest possible loads instead of being absorbed in contending with gravity on *superfluous* inclines, such as we see elsewhere; and if he strictly avoids every expenditure that is not *absolutely essential to open a single track*, he will ensure the desired result. There will be a dividend at the rate of 5 per cent. per annum *paid from revenue* at the end of the first six months from opening to the Collieries; and the public will then be ready to furnish funds for an extension, but not otherwise.

40. The annexed Table (Appendix No. 2,) exhibits the comparative details above referred to in respect to the distance and consequent cost of construction, as well as to the cost of working the line by each route.

41. From these Tables we arrive at the following conclusions:—

|                                                               | Rise in feet. | Fall in Feet. | Total rise and fall. |
|---------------------------------------------------------------|---------------|---------------|----------------------|
| 1st. That on the Hill line from Calcutta to Mirzapore,..... } | 2,044         | 1,804         | 3,848                |
| On the Ganges line ditto, .....                               | 240           | Nil.          | 240                  |

42. That on the Hilly line the regulating inclines  
would be 1 in ... .. 100

On the Ganges line it may be 1 in ... .. 2,000

43. That the whole length of Railway required would be—

By the Hill route with its branches, ... .. 661 miles.

By the Ganges route, ... .. 593

44. That the investment required for a single line would be—

By the Hill route, ... .. £3,695,500

By the Ganges route, ... .. 3,332,500

45. That the annual amount required to pay 5 per cent. interest would be—

For the Hill route,... .. 184,775

For the Ganges ditto, ... .. 166,625

46. That the smallest annual working expenses (in a great measure affected by the regulating inclines of the respective lines) would be—

For the Hill lines, ... .. £175,742

For the Ganges ditto, ... .. 108,290

47. That the amount of interest added to the smallest annual amount of working expenses, (to be defrayed by the revenue of the line) would be—

For the Hill route,... .. £360,517

For the Ganges ditto, ... .. 274,915

48. That the additional subsequent investment required to convert the single lines into double would be—

For the Hill route, ..... £2,253,500

For the Ganges ditto, ..... 2,022,500

49. That with every comparison, as above stated, both as regards the money invested for construction and subsequent working cost, in favor of the Ganges route, it likewise has the advantage of traversing the best traffic district instead of the worst in Bengal.

50. That the revenue from goods and passengers upon which we can calculate with certainty, provided the rates be as low as they are estimated in the Table (No. 2,) would amount to a sum sufficient to pay the interest of investment and working expenses of one train daily in and out by the Ganges line, whilst there must be considerable doubt whether the traffic will pay for the interest and cost of working on the Hill line.

51. That, finally, the Ganges line runs for about 200 miles in the direction of the natural sanitarium of the capital of India, Darjeeling; a fact which it would be inexcusable to leave out of this consideration, when we reflect that the power and efficiency of the British Government in India depend on the health and vigor of our country-men here, and that these would be materially improved by establishing a facile intercourse between the plains and hills of India. From Calcutta to Darjeeling may be 400 miles (about 12 to 20 hours' journey by rail), with a nearly level approach along the Rivers Ganges and Coossee to the foot of the hills, leaving an ascent of about 70 miles, at a slope of say 1 in 100, to reach the summit by a carriage road.

52. As my stay in India is to be very short, I am particularly desirous, before I leave the country, of pressing upon all those engaged in the projection, construction, and control of these great works, the necessity for a rigid observance of some important general prin-

ciples, because I know that the neglect of those principles by our English Engineers has had much to do with the calamities that have fallen on the Railway interest at home. The first of all the principles upon which Railway profits must unquestionably depend is a right selection of levels for the lines. Any one reading the arguments of some of our professional men, and looking at the ordinary gradients on English lines, would imagine that our engineers had some misgivings in their mind as to the existence of such a force as that of gravity in reference to their Railway operations.

53. What is called creating a traffic by running numerous trains daily, with small loads, has led to this indifference about the arrangements requisite to defeat that formidable enemy to an ascending motion. Powerful engines with very light burdens have thus been able, at ruinous cost, to labour up inexcusable gradients, and the disgrace due to those professional men who have left such obstacles, has scarcely yet been discovered, although it has been very instrumental in causing the ruin of thousands.

54. In the level districts of India, within the great ranges of mountain, it will certainly puzzle the ingenuity of engineers to leave such proofs of incapacity behind them in this respect, as the undulating ground of England offered. But if between two given points on our first line I find a question raised as to whether we are to climb up to a summit of 1,380 feet in a barren district and fall again 1,040, when there is an alternative line through a rich traffic country, having but 240 feet difference of level in its whole extent, and if I find that such a question has for several years afforded a fertile subject for discussion, I have a right to be apprehensive for the result of such deliberations, and I therefore feel bound to offer the broadest explanations of principles in my power in order to correct so alarming an indication of error.

55. The experience of England in Railway operations ought to be most valuable to India, and in nothing more than by exhibiting the grave general errors that have been adopted there.

56. From this, India should derive immense advantages, as well as from some of the peculiar differences that exist in the two countries.

57. As regards this first essential of a Railway that I am now discussing, that of making it approach as near as possible to a level, India has incalculable advantages,—*first* in the level character of a vast mass of its surface ; *secondly*, in the existence of a cheap labour market,

which reduces the cost of cuttings and embankments to about one-sixth, or one-eighth, or one-twelfth of what similar works have been known to cost in England.

58. In India the excavation of earth-works and carrying a short distance would be well paid for at 1*d.* per cubic yard, whilst in England this class of work has cost 8*d.* to 1*s.*

59. In India embankments averaging 6 feet high would cost at the ordinary market price of labour about £300 per mile. This in the maniacal days of the Railway fever in England would have cost about £1,500 to £3,000 per mile.

60. Perhaps the most comprehensive comparative views that can be taken of the applicability of Railways to India, in a financial point, will be found in the contracts for the works now in progress on this first section of the experimental line.

61. Some of the largest items in these contracts are to be furnished at rates considerably above the market value, a fact not at all surprising in making the first contract of the kind in Bengal, and yet even at those rates the Railway will, I should hope, be completed under £7,000 per mile, through one of the most difficult districts of India.

62. It is true that the rate of iron is now low, but not so low as we may calculate upon hereafter obtaining Indian iron. I have little doubt that the future average for carefully constructed Railways in India will fall within £5,000 per mile, and that the after-working cost of the lines will be low in proportion as compared with the working cost in England; nor can it be otherwise, if common discretion be applied, because the respective costs should be in the ratio of the cost of labour in the two countries.

63. The call for tenders for contracts, however, must be carefully put forth so as not to exclude the native speculators from competing, otherwise we establish a costly monopoly of the work in the hands of a few individuals.

64. It would be well that the lots should not in any case exceed ten miles, and perhaps five would be still better; that at least three months should be allowed between the time of issuing the notification, and of receiving the tenders; that the working plans, sections and specifications should be fully prepared and published before issuing any call for tenders. The public will thus have the means of comparing the working sections with the ground, and of making the fullest preparatory calculations and local investigations; but the main point *and the difficult one*



*of all* to insist upon, is that contracts should be let in small lots, and on this point the Government, and the Directors of Companies should be firm, as the leaning of almost all engineers in charge of Railways is to the opposite principle. It saves them a vast deal of trouble in the execution and superintendence of the work. I beg to be clearly understood as applying the observation in the most general way, and without having the slightest particular reference to the able and zealous officer at present in charge of the East Indian Railway Company's Works. But I am most anxious to press upon the Government, and upon every Railway Company, the absolute necessity of insisting upon the contracts being given in small lots, if they wish to ensure fair competition, to prevent costly monopoly, and to obtain the real market value for their outlay.

65. This principle does not by any means exclude the large capitalist, but it brings down his tenders to the market rate. It does not prevent the large capitalist from bidding for every lot upon the line and from obtaining every lot, if his tenders are respectively the lowest, but it does prevent the exclusion in his favor of every one else. It will have a most useful effect on the execution of public works generally throughout India, by training up small contractors in the several districts. It will enable the Government to supersede employment at daily wages, which is somewhat difficult to check, and knock down the "daroga" system in the construction and repair of Bengal embankments, which fosters fraud without the possibility of applying any check, and this is a question of the utmost importance as connected with the security of Bengal Railways, the effectual and economical power of controlling the inundations being a first essential to them, as well as to many other interests in India.

66. In framing the table to estimate the cost of working the line, I have for greater caution assumed the rates of an economically managed enterprise at home, where the labor employed would cost at least five times the price that would be paid for native labor in India.

67. When this is considered in reference to the police and traffic departments, as well as to the locomotive and mechanical departments, every doubt of success in a well-managed enterprise of this class in India will vanish.

68. If any one questions the fact of the native mechanics being available for the construction and repair of the locomotive engines, and of every minute or accurate work required for a Railway, it will

only be necessary to visit the operations carried on by Colonel Forbes at the Mint in Calcutta, and all such doubts will be removed. There we find the nicest parts of the machinery constructed by native workmen paid from 15s. to 20s. a month, who execute as much and as good labour as can be performed in England for six times that rate of wages.

69. All that would be required to apply the native resources in this respect, would be one efficient European superintendent in charge of each branch or department.

70. It is quite obvious that the necessity is indispensable of training up native agency in every branch of the work, and it ought to be made imperative by the Government, and by all companies, upon the chief superintendents and engineers of the several lines, to train up the natives for surveying, levelling, engineering, in short for the projection, laying out, superintendence and execution of Railway operations in all their gradations. If this be not done, the main resource of India as regards the economical extension of Railway operations will have been neglected.

The tendency with men coming out fresh from England, is to under-rate the capabilities of the natives of India, and to imagine that their intellect is so low as to render them available only as animals of burden. This mistake tends to the employment of a much larger proportion of costly subordinate European agency than would be at all necessary if proper precautions were adopted.

The interest of all our Railway Companies, and the interest as well as the character of the Government of India, require that this costly and mischievous error should be corrected, by an immediate and energetic application of the precautions required.

71. I find that a class for training natives in surveying and levelling had been established at one time under the authority of the Directors of the East Indian Railway Company, and I would most urgently press the immediate revival of that class upon its original basis. The cost of this measure should be very small indeed, and ought to be strictly defined by regulation. Inquiry at the Surveyor General's Department has fully satisfied me that this training can be easily given, but that without it we cannot be supplied. The results too at that office have satisfied me as to the economy, the quantity and the quality of the work of native surveyors, when proper principles are applied.

72. The present cold season has been nearly wasted as regards construction, from the impossibility of employing Europeans out of doors

during the previous hot season in executing the surveys and sections, which are required by the engineer as a preliminary to the projection of his works.

73. As long as we are limited entirely to European agency in this respect, a similar waste of the valuable cold season must inevitably be the result, in addition to the extravagance of a *ten-fold* cost which is required to pay that European agency, as compared with native.

74. The Engineer of the Railway Company has now employed every qualified European draftsman that he could find (12 surveyors and 6 draftsmen), at a cost of 200 and 150 Rupees per month each, respectively. He still wants at least twice as many as he has got, to enable him to secure that any fresh work may be properly digested and ready to execute at the beginning of the next cold season. A native draftsman, if such could be had, would be quite willing to work at say 20 to 40 Rupees a month, besides being able to go out in the heat that would confine the European in-doors.

75. If we get additional men of this class from England, the waste would be very great indeed, because in the first place their passage must be paid to India and home again, and when brought out, they must be employed permanently, although they are only required temporarily, and although they can only give efficient service for one half of the year, whilst, on the contrary, the Native can be struck off pay the moment that the exigency which called for him is over, and if that exigency lasts after the cold season, he is not disqualified from continuing his exertions in the heat.

76. For all these reasons I repeat my earnest recommendation that as a commencement, a class of 20 well-selected natives, qualified in the preliminary branches of mathematics, should be immediately put into training, under a good practical surveyor, that whilst pupils they should receive a subsistence of 5 Rupees per month each, as long as their progress is satisfactory, and that when properly qualified in surveying and levelling, they should be eligible to receive a regular classified pay as surveyors, or draftsmen; as long as their services might be required.

77. It is indispensable now, in originating a system of Railways for India, to foresee and provide for all those matters that can in any way reduce the cost and increase the security and efficiency of our carrying traffic, without curtailing in any way the power of applying future improvements.

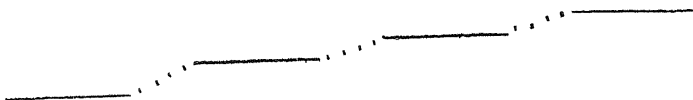
78. These broad objects require that two distinct principles be constantly kept in view :—

*First*,—To secure the means of acquiring the most powerful engines.

*Secondly*,—To ensure that the power thus acquired shall be employed under the most favorable circumstances, so as to be enabled to convey the largest possible loads.

With respect to the first provision, the recommendation of the Marquis of Dalhousie for the adoption of a 6-feet gauge throughout India, if confirmed, will meet every requirement. It will afford ample room for the construction of most powerful engines. It will furnish a safe base for high velocities, without requiring any superfluous magnitude of dimensions in engines, carriages, &c., that could render them unnecessarily cumbrous, weighty, inconvenient, or expensive, whether as regards the question of first cost, or of after-working. With regard to the second principle of providing that the engine power shall be made in all cases applicable to the traction of the largest possible loads, this must depend upon the capability and judgment of the engineer entrusted with the laying out of each particular line, who should always recollect the enormous ratio in which he reduces the loads and increases the cost of transport as he increases his regulating gradients.

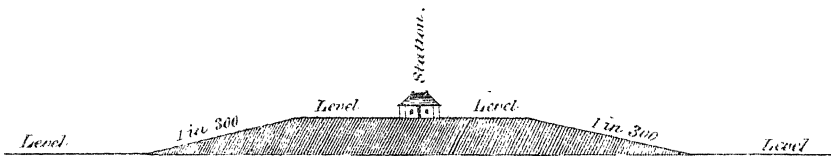
79. His duty then will be, having selected the most advantageous district of country, to bring every part of his line the nearest possible to a perfect level, and where inclines are absolutely indispensable, to use the utmost ingenuity in their application. Much may be done in this way without entailing the necessity of diminishing the load, if he alternates *very short and easy inclines* with level portions of the road, so calculated and disposed that the acquired velocity of every train, when it reaches the foot of the incline, shall be sufficient, in addition to the power of the engine, to enable the train to reach the next level when it can acquire a new increased velocity that shall enable it in like manner to surmount the next short ascent, and so on for any required number of alternate ascents and levels, as in the following example, where the continued lines represent the levels which enable the train to renew its velocity, and dotted lines show the short inclines—



By such a system of laying out the line, very considerable differences of level may be surmounted without materially reducing the load due to the engine on the level track, but much care must be given in calculating the various resistances, and the power of renewing the velocity, not to run matters too close, and even under the adoption of the above alternative principle of levels and very short inclines, I should be much disappointed to find any project brought forward for the level district of Bengal, or the continuation through the Dooab to the North-West, having a maximum gradient beyond 1 in 300 for short inclines, which the train's velocity should make up for, or having a regulating gradient exceeding 1 in 2,000.

80. In addition to the foregoing method of neutralizing the mischievous tendency of gravity of inclines, there is another precaution by which it may be made subservient, instead of inimical to railway interests if introduced with proper care.

By bringing a short ascending incline to aid on each side of every station, a wasteful cause of wear and tear in the use of the break is removed when stopping the trains, and a very desirable assistance is obtained for starting them and accelerating the velocity afterwards, when leaving the station by the descending incline. Assume that we are passing through a perfectly level district when we approach the position for a station, the section might be made as follows :—



81. The delays and preparations generally unavoidable at the first commencement of a new system have been augmented in the present instance by the necessity of making that commencement in the most difficult district of India, where much consideration and examination were requisite in reference to the periodical inundations that prevail ;—the various effects which those inundations were calculated to have upon the works, and the various remedies by which such effects are to be counteracted.

Mr. Turnbull, the Engineer of the Company, on his arrival in India last May, about the hottest season of the year, had at once to deal with these difficult subjects.

It is thus easy to account for the delay that has occurred in furnishing me with the detailed longitudinal section of the line. I was anxious to receive this essential document before offering anything for the sanction of Government ; still, knowing the desire of the Government to afford to the Company every facility, and feeling the importance of economizing the cold weather, I have not hesitated to recommend for sanction small portions of the survey as they could be furnished by the Engineer, and they have accordingly been sanctioned and placed in the hands of the Commissioner for valuation, without waiting for the more usual, and correct mode of having the whole plans and longitudinal section first completed and furnished. I, however, took the precaution of informing myself thoroughly as to the line, by visiting the localities and communicating personally with the Chief and Resident Engineers. Before my arrival, the valuation Commissioner had, under the sanction of Government, afforded every facility to the Chief Engineer to clear the centre line proposed by him to an extent of 20 feet through jungle and plantations. Before the entire completion of this operation, some irregularities in cutting more than was authorized, produced opposition on the part of the landholders, and rendered it necessary to proceed with much caution, and according to the strictest letter of the law ; some delay was thus caused.

This error originated from inadvertence in employing a party of 200 instead of 20 men to clear the centre line, and much caution is required, particularly by limiting the workmen to a very small number, when performing this class of work, otherwise confusion and unnecessary damage must invariably occur. The whole of the centre line has now been set out, with the exception of a very small portion in Serampore, although not one-fourth of the survey has yet been given in to me. The period required in the legal valuation notices has expired as regards the two portions of survey first given in, and the Commissioner, having ascertained the claims of the landholders interested, has just given possession of those lands to the Company, and the embankments upon them are now proceeding. As the Engineer gives in further portions of the survey, I shall continue to recommend them, if the detached parts are satisfactory, without waiting for the whole.

82. The Agent and Engineer thought that upon the publication of the new Valuation Act, they would have been enabled to receive immediate possession of the lands on the whole line, and so they undoubtedly would, if the surveys defining the lands required had been furnished, so as to have enabled the valuation Commissioner to have ascertained the lands and their owners in reference to the adjustment of the legal claims.

83. Neither the Company's Officers, nor my predecessor appear to have appreciated the difference between the costly, mischievous and dilatory procedure which prevails in England in the preliminaries to the sanction of a Railway project, and those wholesome and indispensable forms which it is the wish and the duty of the Indian Government to establish here.

84. The consequence has been that contracts were hastily made for the execution of the work before I arrived here, and before the detailed survey and sections were made of the line. The contractors state that upon the signing of their contracts, they immediately engaged working parties to come from distant parts of the country, and they complain of the delay and inconvenience to which they have been since exposed, whilst the preparation of the plans and the valuations have been in progress. This irregular proceeding may lead to considerable inconvenience and perhaps litigation.

85. I should earnestly urge that no future notification or call for tenders or contracts upon any line of Railway shall on any account be permitted, until after the regular survey of the lands to be occupied, and the longitudinal section, showing the levels and the various works required, shall have been presented to the Government, and most fully considered and sanctioned. The perfection of the line, the nature and security of the works, the interests of the shareholders, the public and the Government, the rights of the owners and occupiers of lands;—in short every rational view of the question demands that this precautionary rule should be most strictly observed.

86. The Government of India, in its general arrangements, has removed all that could be complained of in the English system as regards preliminary procedure and Government interference, but I conceive that the very simple and efficient procedure which has been established for India in its stead should be most strictly enforced, both in spirit and in form. This procedure contemplates an effective previous consideration and control of every project and every act

of the Company, by which either they themselves, or the public can be affected.

87. It is probable that in future works a considerable saving may be made as compared with the present in framing the specifications of work, both as regards the quantity of land required, the nature and cost of the works themselves, and the interests of the landholders along the lines.

The specification of the works and the consequent contracts would require that about 34 acres per mile should be permanently occupied. The continuous drains shown in the section instead of being beneficial would be very mischievous to the works, by opening so close to them what would in fact be two rivulets, and on representing this to the Engineer he agreed to leave cross banks in these cuts, which shall stop the current. He also agreed to bring his fences to the foot of the embankments instead of placing them outside of the excavations; this change reduces the quantity of land permanently required to about 13 acres per mile instead of 34.

88. If the excavation of the earth required for embankments were taken from openings to be made more like tanks than the shallow hollows represented in the section, much less ground would be damaged, and most useful reservoirs for water would be left for the people afterwards, which I have no doubt the owners of the land would consider a full remuneration for all damage done in obtaining the earth for the embankments. The extent to which the natives themselves cut out their land into large holes and tanks to retain supplies of water in the dry season proves how beneficial to them it would be if we formed good tanks for them in procuring our fillings for embankments.

89. On taking charge of my office, I found a question under discussion between the Government Commissioner for valuation, and the Railway Company's Chief Engineer, in regard to the quantity of river frontage required for the Howrah terminus.

90. The Chief Engineer had framed his project with reference to the possible extension of Railways to their utmost limits, so as to afford commodious arrangements at the principal station to meet the maximum demands upon it by the carrying trade of all India under a high state of development.

91. The cost of the frontage thus demanded in the most valuable portion of the Harbour Docking District at Howrah was estimated by



£50,000, but the present (which are much advanced) quotations of the market price of the Dock Company's Stock, indicate an actual value of £28,000.

92. I suggested to the Engineer that whilst it might be quite right to lay before his Directors and the Government his views as to the ultimate possible requirements of the Railway interests in this respect at Calcutta, it was at the same time not reasonable to say that any such scale was required to meet the exigencies of the subject he is now dealing with—a capital under one million Sterling, and a sanctioned line of 40 miles, with a probable extension to 140 miles, where the calculation of goods to be received and despatched during the year could not be expected to exceed 1,50,000 tons, including the coal traffic and say 50,000 passengers.

93. Mr. Turnbull's argument was that the ground which is likely ultimately to be required for the future extension of the terminus accommodation could be obtained at present at a much lower cost than would probably be the case after the establishment of the Railway, which would necessarily have the effect of enhancing the value of all the ground in the immediate neighbourhood of the terminus.

94. I felt that much weight was due to this consideration, but urged that it was merely a consideration, which, although we were bound to lay before the Government for their own unbiassed decision, yet neither he nor I had any right to press, as it did not involve a professional question; and it was for the Government alone to consider whether they chose to lay out a larger sum than is now required on the chance of a future gain, or whether they would prefer giving an additional price for more ground hereafter when the certainty of its being required should arise, and be sustained by the successful issue of the present experimental operations.

95. Under this view I requested that Mr. Turnbull would have the goodness to present alternative projects for a terminus;—*first*, as adapted to the 40 miles of sanctioned Railway; *secondly*, an extension of the first to suit an extension of the line to the Raneegunge Collieries, in case that extension of the line should be sanctioned as recommended; and *thirdly*, a plan showing the power of extending the second project to the utmost limits that our future Railway progress may require. These alternative plans, contemplating a power of adaptation to every progressive state that the Railway project may hereafter assume, are now, I believe, under preparation by the Chief Engineer of the East Indian Railway Company.

96. With respect to the precise position of the Howrah terminus, I think it may be placed with almost equal convenience in any portion of the distance between Howrah Ghât and Sulkea Ghât, thus offering a selection, and competition for sale, over nearly one mile and a half of the river frontage, and I should propose that the several lots in the whole of that distance and running back to the principal road parallel to the river and half a mile from it, should be immediately surveyed and valued, that there may be full data before coming to a decision on this important point. The want of a correct plan of Howrah is very much felt indeed. It is most unfortunate and unaccountable that the late Consulting Engineer of Government in the *Railway Department*, when making a general plan of the capital of India, should have wholly omitted to include Howrah, the position ultimately recommended by himself as the site for the Railway terminus of the capital, and I hope that the addition of this most important district may be immediately made to Mr. Simms' plans.

97. I conceive that within the distance I have stated, the very extensive frontage belonging to the Government itself and occupied by the Salt stores (Gholas,) gives an opportunity of meeting all the present requirements of the Railway Company, in addition to the accommodation required for the Salt, by merely purchasing some additional land immediately behind the Salt premises, the value of which would be very small indeed, as compared with river frontage.

98. If this course were adopted by the Government, it would then only be requisite that the Railway Company should build for the Salt Department as much storage in the rear as they found it necessary from time to time to appropriate in the front, laying down tramways for running in the salt, and thus the present frontage belonging to Government could be made perfectly to meet the requirements of both the Salt, and the Railway Departments, with scarcely any disbursement of funds. At the same time, if a separate and equally good position could be obtained for the Railway Station at a moderate rate of cost, it might be better not to derange the present Salt Stores.

99. I regret that I am obliged to differ with the Chief Engineer in respect to the mode in which he proposes to make the Railway enter the Howrah terminus. He considers that some given disposition of the station buildings is of primary importance to the selection of the best line for the Railway, whilst I consider it very secondary indeed, and he proposes to make the approach to the station on a curve of more than a quadrant: whilst there is the power of bringing it in on a

straight line, I am of opinion that, as a general rule, with the exception of an incline, a curve is the most objectionable thing that can be introduced in a line of Railway, and that the most objectionable place for its adoption is at a terminus. Both inclines and curves are frequently inevitable, still nothing but absolute necessity justifies the adoption of either: and therefore an unnecessary curve at the Howrah terminus would be quite inexcusable.—(See Sketch, Appendix No. 5.)

100. The Agent and Chief Engineer of the Company concur with me in thinking that a very great benefit would accrue from at once establishing the points along the line of Railway, and building forthwith the bungalows that shall ultimately be required for stations, on a prescribed general plan, somewhat similar to the ordinary dawking bungalows. The object of immediately building these Station Houses is to give, during the progress of the work, the accommodation required by the officers close along the line at the several places where their presence is most required for inspection of the contract works. This will be of much importance during the approaching hot season, as a means of securing an efficient superintendence. They will besides do away with the heavy expenses that must otherwise occur for the rent of the numerous offices which are now required and which would then be unnecessary. These rents at present cost the Railway Company at the rate of 2,600 Rupees per annum, so that if the Railway be for two years under the process of construction, the saving on this rent-account would have gone far towards the whole cost of building the Station Houses along the line. The Chief Engineer will immediately send in his plan of these bungalows.

101. I had some misgiving at first as to the efficiency of the system which has been decided upon for the management and control of the East Indian Railway Company's Works, but the more I see of its tendency, the more I am satisfied that it has been fixed upon a sounder basis than any other Railway undertaking with which I am acquainted. The double check of the Railway Company's Directors, and the close Government supervision, should have a most salutary effect as regards the expenditure, provided that a discreet and conciliatory intercourse be maintained between their Officers respectively, and that no capricious differences or frivolous impediments of etiquette, &c., be permitted to interfere with that vigorous propulsion of the work which is essential to its healthy progress.

102. It is for these reasons as regarding the soundness of the present agency, and because I am thoroughly persuaded, on the ground set forth in the foregoing report, that the broad extension of well-managed Railways in India would produce great public benefit to the country as well as profit to the undertakers,—it is upon all these grounds that I feel justified in recommending to favorable consideration the general extension project which Mr. Stephenson, as Agent for his Company, has forwarded through me to the Government.—(See Appendix 6.) I think that Railway Management under a Company *strictly controlled by Government*, is much better than it would be under the single superintendence of either a Company or Government separately. In reference to the sequence or order in which the extensions of the line will most usefully and advantageously be carried out, I shall be prepared, on my return from the inspection of the Ganges Valley, to submit my opinion and suggestions for the consideration of Government on what may be regarded as one of the most important questions upon which they will have to decide.

103. And I think there is a considerable advantage in extending the principle of railways through the instrumentality of one such company rather than of several, both on account of the economy and of the efficiency that could thus be maintained. There would be but one set of expensive chiefs instead of many; and a smaller number of subordinates moveable from place to place would likewise suffice.

104. If the principle of extending the work under the present East Indian Railway Company be adopted, what I have proposed in paragraph 71, &c., would be applicable, by the Chief Engineer of the Company appointing his most capable assistant to go forward with the Native draftsmen who might become qualified as such, and furnish to the Chief Engineer such reports, plans and sections as he might call for in reference to any particular line or district. By this course, it is certain that the requisite preliminary examination of districts could be made, which is now impossible, except at a sacrifice of time which would render the extension of Railways very tedious and expensive indeed.

105. If, however, that broad extension of Railways can be accomplished in India which the interests of both India and England require, and which *ought to produce* ample profit to those who embark their money in them, it can only be by the most prudent management; by forcing upon all entrusted with expenditure, the inevitable necessity of economy; by avoiding wasteful outlay upon ornamental and useless

works; by a judicious and previously well-considered application and use of the funds: by careful forethought, arrangement and calculation, and by giving the fullest periodical publicity to every thing affecting the expenditure.

The following extract from an official Report to the Government, dated 29th April, 1850, now before me, proves that in Railway matters the doling-out principle, in contradistinction to the old method of exuberant supply, has already protected India from a heavy disaster.

This writer innocently states—

“ 27. I have thought it necessary to enter upon the subject of the  
“ Calcutta terminus at some length, because in a report addressed to  
“ W. Grey, Esq., Private Secretary to Sir T. Herbert Maddock, the late  
“ Deputy Governor of Bengal, dated 22nd of May, 1846, I expressed  
“ myself in favor of bringing the Railway into the heart of the Town,  
“ and it is therefore due to myself now to state that when that Report  
“ was penned, there appeared to be every probability of an abundance  
“ of money to carry out the whole of the Railway project from Calcutta  
“ to Delhi and with Bridges spanning the great rivers, the Jumna,  
“ Soane, and the Hooghly, and therefore in so magnificent a project  
“ the extra outlay (large as it would necessarily be) to make so great  
“ a work quite complete by bringing the Railway into the heart of the  
“ Town, would, under such circumstances, be quite unworthy of consi-  
“ deration, in comparison to the whole cost of the undertaking.

“ Upon the preceding considerations, I have, in following my inves-  
“ tigations, considered Howrah as the proper site for the Railway  
“ terminus, no other plan appearing so feasible under existing cir-  
“ cumstances.”

Assuredly a more simple or guileless confession never before was made. But it is so full of import as a warning against supplying Railway Engineers, or indeed any Engineers, with “an abundance of money,” which inevitably leads to exuberant projects, careless specifications and loose estimates, that I feel compelled to especially refer to the quotation for the benefit of all future Public Works in India. “So magnificent a project” and so reckless a system would not probably have yielded to their confiding dupes one per cent. on investments which by rational management ought to be largely remunerative.

I must request the indulgence and consideration of the Government to any imperfections in this Report, in consequence of the limited time

at my disposal, and which has prevented my entering so fully as I could otherwise have desired into the various details of the Railway question.

I have the honor to be, &c.,

(Signed) J. P. KENNEDY, *Major,*  
*Consulting Engr. to the Govt. of India,*  
*Railway Department.*

*P. S.*—The construction of the first Railways in India has been most correctly termed an experiment, not arising from any doubt as to whether the requisite engineering works can be constructed, nor as to whether there are sufficient quantities of goods and passengers to be conveyed, but simply as to the facts of whether Government rules can be framed, and engineers can be found free from the extravagance of the English practice, so as to secure results remunerative to those who invest their money.

(Signed) J. P. K.



## APPENDIX No. 2.

*Comparative Table showing the Estimated number of Miles of Railway and their Cost in Construction and subsequent working between Calcutta and Mirzapore.*

| By level or Ganges Route passing by Raneengunge Collieries, Rajmehal Patna, &c. Regulating gradient 1 in 2,000,      |               |                                |                                  |                                       |                   |         |               |                                |                                  |
|----------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------|----------------------------------|---------------------------------------|-------------------|---------|---------------|--------------------------------|----------------------------------|
| By Mountainous Route, with its three branches, leading to Rajmehal, Patna and Benares. Regulating gradient 1 in 100. |               |                                |                                  |                                       |                   |         |               |                                |                                  |
|                                                                                                                      | No. of Miles. | Cost of Construction per Mile. | Investment for Construction, &c. | ANNUAL EXPENDITURE.                   |                   |         | No. of Miles. | Cost of Construction per Mile. | Investment for Construction, &c. |
|                                                                                                                      |               |                                |                                  | Interest on Investment at 5 per cent. | Working Expenses. | Total.  |               |                                |                                  |
| Calcutta to Pundowah, .. ..                                                                                          | 40            | 7,000                          | 280,000                          | 14,000                                | 7,280             | 21,280  | 40            | 7,000                          | 280,000                          |
| Pundowah to Raneengunge Collieries, .. ..                                                                            | 90            | 5,500                          | 495,000                          | 24,750                                | 16,380            | 41,130  | 90            | 5,500                          | 495,000                          |
| Raneengunge to Mirzapore, .. ..                                                                                      | 320           | 5,500                          | 1,760,000                        | 88,000                                | 111,640           | 199,640 | 405           | 5,500                          | 2,265,000                        |
| Ditto add for Correction, .. ..                                                                                      | 16            | 5,500                          | 88,000                           | 4,400                                 | 5,552             | 9,952   | 1             | 5,500                          | 5,500                            |
| 1st Branch to Rajmehal, .. ..                                                                                        | 140           | 5,500                          | 770,000                          | 38,500                                | 25,480            | 63,980  | 1             | 5,500                          | 5,500                            |
| 2nd ditto to Patna, .. ..                                                                                            | 40            | 5,500                          | 220,000                          | 11,000                                | 7,280             | 18,280  | 1             | 5,500                          | 5,500                            |
| 3rd ditto to Benares, .. ..                                                                                          | 15            | 5,500                          | 82,500                           | 4,125                                 | 2,730             | 6,855   | 1             | 5,500                          | 5,500                            |
| Total, .. ..                                                                                                         | 601           | 0                              | 3,635,500                        | 184,775                               | 175,744           | 360,517 | Total, .. ..  | 605                            | 0                                |
|                                                                                                                      |               |                                |                                  |                                       |                   |         |               |                                | 3,996,015                        |

The Calculations in these Tables are necessarily vague as being Estimates made in anticipation. They can be and ought to be corrected when the portions of line become accurately known, when the longitudinal sections are precisely laid down, and when the works are accurately specified. I should not be justified, however, in delaying to offer the best proximate scale in my power, and I believe the elements that I have used in this scale are the only ones that can be relied upon as leading to sound conclusions.

(Signed) J. P. KENNEDY.



## APPENDIX No. 3.

|                                                                                    | MILEAGE COST PER ANNUAL.      |                   |                     |                    |                    |                   | REVENUE.                                                                       | £      |
|------------------------------------------------------------------------------------|-------------------------------|-------------------|---------------------|--------------------|--------------------|-------------------|--------------------------------------------------------------------------------|--------|
|                                                                                    | For 1 Train daily in and out. | Two Trains daily. | Three Trains daily. | Four Trains daily. | Five Trains daily. | Six Trains daily. |                                                                                |        |
| Maintenance of Way and Hauleage,...                                                | 50                            | 100               | 150                 | 200                | 250                | 300               | 75,000 Tons of Coal from Raneeunge to Calcutta 120 at 0½d. per ton per mile.   | 28,175 |
| Traffic and Dep'ts'. Management, }<br>&c., .. .. .                                 | 182                           | 187               | 142                 | 147                | 152                | 157               | 35,000 Ditto Goods, .. .. . 120 at 1d. ,, ditto, ..                            | 23,505 |
| Total working Cost per Mile, ..                                                    | 182                           | 237               | 292                 | 347                | 402                | 457               | 730 1st Class passengers, being 2 per day @ 4d. per mile for 130 miles, ..     | 1,581  |
| Working Cost on 130 Miles between }<br>Calcutta and Collieries, ..                 | 23,669                        | 30,810            | 37,060              | 45,110             | 52,260             | 59,410            | 1,400 2nd Class ditto, .. .. 4 ditto 8d. ditto, .. .. .                        | 2,972  |
| Add Interest on Investment of }<br>£775,000 at 5 per Cent. per }<br>Annum, .. .. . | 88,750                        | 88,750            | 88,750              | 88,750             | 88,750             | 88,750            | 2,920 3rd Class ditto, .. .. 8 ditto 2d. ditto, .. .. .                        | 3,161  |
|                                                                                    |                               |                   |                     |                    |                    |                   | 5,840 4th Class ditto, .. .. 16 ditto 1d. ditto, .. .. .                       | 3,102  |
|                                                                                    |                               |                   |                     |                    |                    |                   | 11,680 5th Class ditto, .. .. 32 ditto 0½d. ditto, .. .. .                     | 3,102  |
| Total of Interest and Working Costs }<br>on 130 Miles, .. .. .                     | 62,410                        | 60,560            | 70,710              | 83,560             | 91,010             | 98,160            | 110 Tons and 22,690 Passengers, Total Annual Revenue which is nearly certain £ | 65,118 |

## APPENDIX No. 6.

### EAST INDIAN RAILWAY.

*To the Chairman and Directors of the East Indian Railway Company.*

DATED SERAMPORE, 3RD JANUARY, 1851.

GENTLEMEN,

I HAD the honor of reporting to you on the 6th August last, that tenders had been received from seven parties for executing the 40 miles of Railway from Howrah to Pundowah. On the 6th September last, sanction was given by the Government of India to the acceptance of the tender of Messrs. Hunt, Bray and Emsley, of London, for the first 25 miles of the line from Howrah to a place in the neighbourhood of Hooghly, and of the tender of Messrs. Burn and Co., of Calcutta, for the next 15 miles, terminating near the village Pundowah.

2nd. Application was made to Government for permission to clear away the jungle and trees on the centre line of the Railway, for the purpose of marking out the same, and making the necessary surveys and sections, pending the passing of the new Legislative Act. This Act came into force on the 20th December last, and Mr. Lushington, Commissioner under the Act, is taking active steps for obtaining possession of such land as may be required. I regret, however, to add, that up to this date, we have not been put in possession of any land. Every effort has, however, been made so far as it could be done, by consent of the parties occupying the lands, to open out a track along the centre line, and a considerable amount of clearance has been made, and surveys and sections already taken. Of the 40 miles, there now only remain about 5 or 6 miles of jungle and trees to clear, on the centre line about 15 miles have been surveyed, and about 10 miles of the sections effected, and I confidently expect that the whole will be done before the close of the present month. A portion of the embankment, about a quarter of a mile in length, near Balli Khall, has been raised to its full height, and completed in a creditable manner, but from want of possession of land, further progress of this work has been stayed in the meantime.

Judging from the ease and rapidity with which this embankment has been thrown up, I expect that unless extraordinary delay takes place in obtaining possession of land, the whole of the embankments may, with due vigilance and exertion, be completed against the approach of the rainy season of this year, that is, about next midsummer, at which time also the heavy works of brick-work in bridges and culverts will be commenced. Little or no progress has been made in brick-making, for want of land, but this will now proceed as well as the season will permit, so as

to enable us to carry on all the brick-work in the rainy season ; which in this country is the best time of the year for building operations. Seeing that an extension of the Railway from Pundowah Westwards, through Burdwan into the Damooda coal-field, has been recommended by the Governor General of India, and that a decision in accordance with his Lordship's views may be anticipated from the Hon'ble Court of Directors, I judged it incumbent on me to make minute examination of the country Westward, taking trial levels and surveys in several directions, such as to enable me to lay down a line with a continuous rising gradient into the middle of the coal-field and terminating at such point as would be suitable for a continuation forward to Mirzapore, should this direct route be adopted, or that if the Ganges valley route to Mirzapore be preserved, that this line would be the best *branch* for opening up the fine coal-field lying between the valleys of the Rivers Damooda and Adjai.

The result of my investigations may be stated as follows :—Extension from Pundowah Westwards into the coal-field lying between the Rivers Damooda and Adjai.

The large village of Pundowah is situated on the Grand Trunk Road, about 42 miles from Calcutta. The line will pass on the South side of the village, thus avoiding the low land on the North side thereof, and also avoiding interference with the Native Cottages and other buildings. Curving to the Westwards, the Railway will cross the Trunk Road about two miles West of Pundowah on the present level of the road. It then proceeds in a straight line Westwards between the large village of Boinchee and the Trunk Road, keeping on the North side of the latter, until it reaches Memary, when it re-crosses the road near the present Dak Bungalow. This place is about 13 miles from Pundowah, and here a station may be conveniently placed.

Some parts of the above length is subject to floods, and embankments and flood arches will be required. The line proceeds Westwards in a straight direction, South of the Trunk Road, and crosses it again near the encamping ground at Dallu Bazaar, which is about 18 miles from Pundowah. It then keeps on the North side of the road, passing between it, and the large water-course called the Banka Nuddy, proceeding towards Burdwan on the highest ground that can be selected, and crossing the Banka Nuddy near Gopal Battee, where it will curve Northward towards the encamping ground at the Dak Bungalow, and Post Office at Burdwan, which is the best place for erecting the Burdwan Station. From Pundowah to Burdwan, the distance is 40 miles. With the exception of a large bridge and flood-arches, at the Banka Nuddy, and two others similar in character, but of somewhat smaller dimensions, for the flood waters near Dallu Bazaar and Memary, the works on this length of 30 miles will be of a light description. The ground is practically level, and the alluvial soil is similar to that of the district between Howrah and Pundowah.

The floods in the Banka Nuddy and all other water-courses in the length described, are of a formidable kind, overtopping the Trunk Road in several places, and much precaution will be necessary by giving ample vent for the floods by arches and openings in the embankments in addition to the bridge arches, in order to

prevent injury to the works from the almost periodical bursting of the bunds of the Damooda and consequent inundations of the plains.

From Burdwan proceeding Westwards, the surface of the country presents the same uniform aspect for a distance of about 30 miles. When passing the large village of Caksa, it begins slightly to undulate, throughout the distance the line keeps on the North side of the Trunk Road, maintaining an almost straight line. For about 3 miles West of Burdwan, the present road is occasionally flooded, but the remainder is beyond the reach of the floods. The works on this part, 30 miles long, will be of the lightest possible kind, no high embankments, and not many culverts and no large bridges will be necessary.

Near Caksa, the line again crosses the Trunk Road, and proceeds on the South side of it, nearly in a straight direction to the village of Gobinathpore, a distance of about 10 miles, near which village the line leaves the alluvial plains of Bengal and crosses the Eastern limit of the Damooda coal-field. It then pursues a North-Westerly direction, parallel to the Damooda, at about the distance of a mile from it, crossing the tributary Rivers or Nullahs Tumlah and Singarrow, passing close to the three collieries, Rugonauth Chuck, Narain Coory, and Raneegunge, a little beyond which last, it will cross the Nooneah, another tributary of the Damooda, and proceed nearly in a straight line to the Grand Trunk Road, near Ahsensole, not far from the Dak Bungalow, at the 136th mile from Calcutta, where it is proposed that the line should terminate for the present.

From Caksa to Ahsensole the distance will be about 36 miles, the whole distance from Pundowah to Ahsensole will be about 95 miles.

From Caksa to the limit of the coal-field, the country is of a slightly undulating character, but no works of magnitude will be wanted ; the embankments and cuttings are slight.

From the limit of the coal-field to Ahsensole the country consists of land, more or less undulating ; the tops of the ridges are covered with an iron conglomerate, sometimes met with in the shape of gravel, admirably adapted for ballast. The rock beneath is an easy-wrought land stone, which is found in places available for the construction of bridges and culverts ; good sand, and kunker limestone also abound throughout the district. The earth-works on this portion of the line will be comparatively greater than on the Eastern part of the Railway, cuttings and embankments are unavoidable, but none are of much extent, none will exceed a height or depth of 30 feet, and the material in which they are worked is of a favorable description for both cuttings and embankments.

Large bridges will be required for crossing the Rivers Tumlah, Singarrow and Nooneah. They will be all of the same kind, built of stone found in the neighbourhood, and it is expected a rock foundation may be had for all these bridges.

The line here proposed will be easily accessible to the numerous collieries already at work, and equally accessible for any that may be opened, on the Southern side of

the coal-field, an easy descending gradient being obtainable through the valleys of the three rivers mentioned above.

There are numerous collieries and large beds of coal to the West and North of Ahsensole, but until it be determined whether the Railway is ultimately to be extended by this line through the hills to Mirzapore, it would not be prudent to carry it further, as the selection of the extended line would guide the further direction of the line beyond Ahsensole.

The line here described, between Pundowah and Ahsensole, is laid out with a view either to its being a part of a direct Railway to Mirzapore, or as only a branch Railway into the Damooda coal-field.

From Ahsensole to Howrah a descending gradient can be got for the whole of the distance, which is of peculiar advantage to the heavy traffic of a coal Railway. Saul timber, well suited for sleepers, can be found at a very cheap rate in this district.

Besides coal traffic, it appears reasonable to expect that trade will arise in transporting building-stone to Calcutta, also kunker, limestone, saul timber, and possibly the iron conglomerate.

I have, with my assistants, Messrs. Purser and Evans, explored the country in various directions, taking trial levels as much as the limited time for out-door work would permit.

These investigations of the country were carried forward to the Barrakur, about 10 miles up that river from its junction with the Damooda, and I am enabled to state, from personal examination, that the line may be continued with moderate cuttings and embankments, in a North-Western direction, to the North of the Deybeelan Hills, passing between the ranges of hills and the River Adjai. An extensive and beautiful as well as a highly interesting view is obtained from the top of the East Deybeelan Hills at a bend of the River Barrakur. The hills, which are covered with small jungle wood, are situated all on the River Barrakur, and no line of Railway could probably be obtained, without many windings on the river banks. On the North of these hills, however, the country for many miles seems to be much the same as that about Ahsensole, consisting of undulations of great height, the general level of the country gradually rising to the North-West.

My two assistants mentioned above are actively engaged marking out the line on the ground, and taking longitudinal working sections of it.

When this is completed, accurate estimates as well as detailed plans of the bridges and other works, may be made, with the purpose of letting the works to contract in the event of the order of Government for doing so being obtained.

The course of the Railway, here proposed, is exhibited on the map accompanying this report.

I have the honor to be, &c.,

(Signed) GEO. TURNBULL.

## APPENDIX No. 7.

No. 93.

FROM R. M. STEPHENSON, Esq.,

*Agent, East Indian Railway Company,*

TO MAJOR J. PITT KENNEDY,

*Consulting Engineer to the Government of India.*

CALCUTTA, THE 16TH JANUARY, 1851.

SIR,

*Enclosures.*

- 1.—Map of Railway Lines.
- 2.—Suggestions for extensions.
- 3.—Table of Distances and Cost.
- 4.—Annual Receipts and Expenditure of Capital.

I HAVE the honor to enclose a memorandum of suggestions for the extension of the Railway operations, at such period, in such direction, and to such extent, as shall be deemed desirable, and recommended for the

consideration of the Home Authorities by the Government of India, and

I have the honor to be, &c.,

(Signed) R. M. STEPHENSON,

*Agent to the East Indian Railway Company.*

No. 2.

## EAST INDIAN RAILWAY.

It is needless and unavailing to recur at any length to the fact that nearly seven years have been permitted to pass since the proposals were made to construct the East Indian Railway, except for the purpose of indicating such a course for immediate and future adoption as shall effectually prevent the continuance of so deplorable a policy. The retrospect is instructive. In 1844, specific offers were submitted to the authorities in India and in England for constructing one or more lines of Railway, and documents and data (carefully collected during preceding years) are by all admitted to undeniably attest the importance and value of such works to the governors and the governed. Active operations have now at the close of 1850 scarcely commenced. The interval has been occupied with discussion, doubts, objections, and their solution and removal.

At the commencement of 1851, the practicability, the usefulness, and indeed the indispensable necessity of constructing at least the great trunk lines of the country will probably be undisputed.

Any reasonable and practical suggestion by which this object can be most readily accomplished may therefore be entitled to consideration.

The general principles upon which these works are to be carried out, having been arranged, and the machinery for their development organized, the more extended the sphere of action, within reasonable limits, the more economical and effectual will be the operation of such agency. The same board and establishment can as readily proceed with the construction of 1,000 as with 100 miles.

The plan of supervision which has been devised and put in practice is found to be effectual and secures the previous concurrence of the Government to all expenditure and proceedings.

The public, constituting the proprietary body, are satisfied with the security upon which they have agreed to advance their money, and in the present state of the money-market, would be prepared to extend these advances considerably.

The admission that the works are required—that they are already decided on—and the knowledge that the European money-market (ever varying and only to be advantageously availed of at such periods as the present) is most favorable for legitimate investment on an extended scale ; that the prices of iron, and the value of skilled labour are at an unusually low point,—and that during the ensuing few years it will be equally practicable to complete the great chain of communication as to form two or three comparatively worthless links, should, and it is to be hoped will, have their due weight in deciding the course of proceeding on which the interests of the whole of India so materially depend.

Any lengthened comment on a subject already so fully discussed, and on which eventually one common view is taken of the urgency for despatch in the construction of such works, will be unnecessary.

The only two remaining considerations are the means by which to effect what is acknowledged to be the immediate object, and the most judicious adaptation of those arrangements to the successive periods of their performance.

The accompanying Table will show the operation of the suggestion to at once avail of the state of the money-market to raise the Capital of the Company to £20,000,000, a sum estimated in round numbers as sufficient for the construction of the 1,900 miles laid down on the plan by which the two great trunk lines of the country, with several of the most immediately required tributaries, will be simultaneously in course of construction and completed within the same moderate period that it will otherwise take to make any fragmentary part of them.

By a distinct intimation at the outset of the intentions in regard to the dates at which the monies will be required to be paid up, the proprietary will be enabled to reduce or increase their stock accordingly. The interests of the proprietary in obtaining the earliest possible completion of their work as a whole, will, it is believed, induce their ready concurrence in the proposed plan of appropriating the funds by which the accruing interest will be chargeable on, and repaid out of, the half surplus profits above the first five per cent. which is applied to the re-imbursement of the advanced and guaranteed interests. The application of five millions annually to the Railways is

contemplated, but in the event of any interruption arising to render so large an expenditure unadvisable, the funds will remain in the possession of the Hon'ble East India Company available for reducing loans or other temporary purposes.

No argument has yet been urged of sufficient weight to controvert the impression that such a course would be both practicable and beneficial.

What is essentially required to secure its accomplishment is the united co-operation of the authorities with the Railway administration in a clearly-defined and well-digested course of proceeding, without which the delays and obstacles, which have hitherto inflicted such serious injuries upon the cause, and which are mainly attributable to the great diversity of views and opinions entertained, will, in all probability, recur, and defeat the realization of an object which cannot be regarded otherwise than as deserving the cordial concurrence of all parties. The map indicates the lines in sections, and the accompanying Table shows the approximate distances and average cost of construction. The second Table refers to the periods for raising and the appropriation of the Funds.

The selection of the sections which should be earliest constructed to combine the greatest benefit to the Government in a political and military point of view, to the Commercial community, to the European and Native population, generally, and to the shareholders in regard to the most profitable application of the funds, depends upon the decision of the Government, whether they will require the communication between Calcutta and the North-West Provinces to take the most direct course, or to follow the circuitous route of the Ganges Valley.

In the former case the sections which should be at once simultaneously undertaken, are shown on the plan as BCD and E.

In the latter case the selected sections should be E. and K.

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## No. 3.

A.—IN PROGRESS—COST ON AVERAGE £ 400,000

*Alternative Lines to proceed with*

|                   |         |           |   |             |                                                                           |
|-------------------|---------|-----------|---|-------------|---------------------------------------------------------------------------|
| <i>B</i> _____    | Costing | £900,000  |   |             |                                                                           |
| or <i>B</i> _____ | „       | 900,000   | } | £ 2,300,000 | } Cost estimated on average of £ 10,000 per mile, single line first laid. |
| and _____         |         |           |   |             |                                                                           |
| <i>K</i> _____    | „       | 1,400,000 | } | £ 2,300,000 |                                                                           |
| or <i>B</i> _____ | „       | 900,000   |   |             |                                                                           |
| and _____         |         |           | } | £ 2,300,000 |                                                                           |
| <i>E</i> _____    | „       | 1,400,000 |   |             |                                                                           |
| or <i>B</i> _____ | „       | 900,000   | } | £ 3,700,000 |                                                                           |
| <i>E</i> _____    | „       | 1,400,000 |   |             |                                                                           |
| and _____         |         |           | } | £ 3,700,000 |                                                                           |
| <i>K</i> _____    | „       | 1,400,000 |   |             |                                                                           |
| or <i>B</i> _____ | „       | 900,000   | } | £ 4,500,000 |                                                                           |
| <i>C</i> _____    | „       | 2,050,000 |   |             |                                                                           |
| and _____         |         |           | } | £ 4,500,000 |                                                                           |
| <i>D</i> _____    | „       | 1,550,000 |   |             |                                                                           |

## APPROXIMATE DISTANCES.

| From Howrah      | To Hooghly, .....       | 25  | Miles — | <i>A</i> |                                                            |
|------------------|-------------------------|-----|---------|----------|------------------------------------------------------------|
| „ Hooghly        | „ Pundowah, .....       | 15  | „ 40    | <i>A</i> |                                                            |
| „ Pundowah,      | „ Burdwan, .....        | 35  | „ 75    | <i>B</i> |                                                            |
| „ Burdwan        | „ Raneegunge, .....     | 55  | „ 130   | <i>B</i> |                                                            |
| „ Raneegunge     | „ Junction of 2 Rivers, | 25  | „ 155   | <i>C</i> | } Superseded<br>M. if Ganges<br>Valley Line is<br>adopted. |
| „ River Junction | „ Soane, .....          | 180 | „ 335   | <i>C</i> |                                                            |
| „ Soane River    | „ „ .....               | 2½  | „ 337½  | —        |                                                            |
| „ Soane          | „ Chunar, .....         | 80  | „ 417½  | <i>D</i> |                                                            |
| „ Chunar         | „ Mirzapore, .....      | 22½ | „ 440   | <i>D</i> |                                                            |
| „ Mirzapore      | „ Allahabad, .....      | 50  | „ 490   | <i>D</i> |                                                            |
| „ Allahabad      | „ Cawnpore, .....       | 140 | „ 630   | <i>E</i> |                                                            |
| „ Cawnpore       | „ Agra, .....           | 160 | „ 790   | <i>F</i> |                                                            |
| „ Agra           | „ Delhi, .....          | 120 | „ 910   | <i>G</i> |                                                            |
| „ Delhi          | „ Lahore, .....         | 300 | „ 1210  | <i>H</i> |                                                            |
| „ Soane          | „ Hosungabad, .....     | 470 | „ 1630  | <i>I</i> |                                                            |
| „ Pundowah       | „ Rajmehar, .....       | 140 | „ 1820  | <i>K</i> |                                                            |
| „ Trunk          | „ Patna, .....          | 80  | „ 1900  | <i>L</i> | } Superseded<br>M. if Ganges<br>Valley Line is<br>adopted. |

## No. 4.

Capital Account One Million Sterling in 50,000 Shares of £20 each

To be increased to £20,000,000 by issue of 950,000 additional Shares of £20

Payments to be made in sums of £1-5-0 per Share every three Months—the whole to be paid up in four years.

| RECEIPTS FROM CALLS.                              |            |           |           |           |           | APPROPRIATION TO WORKS.                  |            |           |           |           |           |              |
|---------------------------------------------------|------------|-----------|-----------|-----------|-----------|------------------------------------------|------------|-----------|-----------|-----------|-----------|--------------|
|                                                   | 1840-1850. | 1851.     | 1852.     | 1853.     | 1854.     | Section.                                 | 1850-1851. | 1852.     | 1853.     | 1854.     | 1855-6.   | TOTALS.      |
| Paid by deposit and calls about, ...              | £ 500,000  | .....     | £ .....   | £ .....   | £ .....   | A                                        | 300,000    | 100,000   | .....     | £ .....   | £ .....   | £ 400,000    |
| First quarter call of £ 1-5-0 per Share, ..... {  | .....      | 1,250,000 | 1,250,000 | 1,250,000 | 1,250,000 | B                                        | 600,000    | 800,000   | .....     | .....     | .....     | 900,000      |
| Second quarter call of £ 1-5-0 per Share, ..... { | .....      | .....     | .....     | .....     | .....     | C                                        | 500,000    | 500,000   | 800,000   | 250,000   | .....     | 2,050,000    |
| Third quarter call of £ 1-5-0 per Share, ..... {  | .....      | 1,250,000 | 1,250,000 | 1,250,000 | 1,250,000 | D                                        | 300,000    | 300,000   | 600,000   | 350,000   | .....     | 1,550,000    |
| Fourth quarter call of £ 1-5-0 per Share, ..... { | .....      | .....     | .....     | .....     | .....     | E                                        | 500,000    | 500,000   | 400,000   | .....     | .....     | 1,400,000    |
|                                                   |            |           |           |           |           | F                                        |            |           |           |           |           |              |
|                                                   |            |           |           |           |           | G                                        |            |           |           |           |           |              |
|                                                   |            |           |           |           |           | H                                        |            |           |           |           |           |              |
|                                                   |            |           |           |           |           | J                                        |            |           |           |           |           |              |
|                                                   |            |           |           |           |           | K                                        |            |           |           |           |           |              |
|                                                   |            |           |           |           |           | L                                        |            |           |           |           |           |              |
|                                                   |            |           |           |           |           | Totals, .....                            | 2,900,000  | 3,700,000 | 4,800,000 | 4,000,000 | 4,700,000 | 13,700,000   |
|                                                   |            |           |           |           |           | Balance in hands of the East India Co. } | 2,900,000  | 3,700,000 | 4,800,000 | 4,600,000 | 4,700,000 | .....        |
|                                                   |            |           |           |           |           |                                          | 3,800,000  | 4,600,000 | 4,800,000 | 4,700,000 | .....     | £ 20,000,000 |

## REPORT No. 4.

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TO THE CHAIRMAN AND DIRECTORS OF THE EAST INDIAN  
RAILWAY COMPANY.

SERAMPORE, 26TH FEBRUARY, 1851.

GENTLEMEN,

1. In the first Report which I had the honor of addressing to you, dated the 29th May, 1850, I alluded to what I then denominated "the most important question" relating to the East Indian Railway, namely, whether it is most advisable that the line should be carried, in what is called the "direct route," through the Ramghur hills, or by the more circuitous one, by the way of the valley of the River Ganges. Until this question was decided, I recommended that the line should not be carried further than a point which should be common to both the routes indicated.

2. It was not until the 10th of the present month that an opportunity offered of examining the two proposed lines, and in company with Major J. P. Kennedy, Consulting Engineer to the Government of India, I made a cursory examination of the country; proceeding by Rajmehal, Bhaugulpore, Monghyr, and Patna, visiting the River Soane, and returning by the Dunwa pass through the Ramghur hills, by Ahsensole and Burdwan.

3. Although, as I have stated, our examination of the country was only a cursory one, yet its general features are so broadly marked and well defined, that in an engineering point of view we had no difficulty in coming to the conclusion, after much careful investigation, that the Ganges route was in every respect preferable to the other. They both present difficulties, but the balance is immeasurably in favor of the Ganges line.

4. The vast plain of Bengal is intersected by an elevated belt of hilly country, very irregular in width, stretching in a North-East and South-West direction, almost touching the Ganges at Rajmehal, where it may be only about 50 miles broad. In the district of Ramghur, it may be described as about three times that breadth. The Grand Trunk Road to Benares crosses this hilly country, and by the "direct route" the Railway must traverse it also. The height of what is

called the Dunwa pass is about 1,280 feet above Calcutta, and although it would, in all probability, be found that a line might be selected through these hills with a lower summit level, yet from the view obtained of the continuous outline of hills on the West face, which presents itself on the Behar side, and from information collected from those familiar with the country, and especially from Dr. McClelland's Geological Report, which gives tabular heights at various points, there seems no hope of obtaining a lower summit than 1,000 feet above Calcutta without resorting to a long tunnel, a work which is not to be thought of.

5. Moreover this district is much broken up into small valleys and ravines, intersected by mountain streams, which are most of them dry in the dry season, but become impetuous torrents during the rains.

6. To overcome the summit above-named, a uniform rising gradient cannot be obtained without very great expense in cutting through the gneiss rocks, which constitute the chief geological feature of the district.

7. It is not to be expected that a better gradient than 1 in 100 can be obtained, and not even that, without heavy cuttings and embankments, and large and expensive bridges.

8. As the branch Railway into the Damooda coal-field has been sanctioned, and will be carried into effect, every object as regards the minerals of the district will be thus secured.

9. The district in question is comparatively poor, and the population scanty, and no minerals of value are found after leaving the coal-fields. Of the portion between the Barrakur and the Damooda, about 90 miles in length, Dr. McClelland states—"There is a total absence, so far as I could see, of any useful timber tree on the hilly portions of the table-lands. Saul grows luxuriantly in some places, but from want of soil or other causes it never attains a large size." He adds, "The extent of mountain-land is about 25 per cent. of the general surface; another 25 per cent. may be considered either under cultivation or pasture, while 50 per cent. is waste table-land."

10. The crossing of the river Soane at the place intersected by the direct route presents a great difficulty: it is about  $2\frac{3}{4}$  miles wide in the rainy season, and at other times presents a broad expanse of loose sand on each side of the stream.

11. I have thus enumerated the chief engineering objections to the direct route, namely, the difficult and expensive nature of the

obstacles to be encountered, especially through the Ramghur hills, the objectionable gradients of 1 in 100 for many miles, entailing a constant working expense of about double what would be required if the line were level, and the crossing of the River Soane.

12. With respect to the Ganges route, it may be stated in general terms that the country is practically level from Calcutta to Benares, a distance of about 500 miles, the rise of the country, which nearly coincides with that of the rivers is about 240 feet, or somewhat less on the average than six inches per mile.

It would be difficult to exaggerate the importance of first-rate gradients on such a vast line of Railway as the one in contemplation, extending from Calcutta to Delhi in the North-West, a distance of 1,000 miles and upwards, where the chief source of revenue will be the conveyance of goods, and where the locomotive could be brought to exert an uniform maximum rate of working both in load and speed for the whole of the way. From the longitudinal sections already taken, and from all I can learn from undoubted authority, the country for one-half of the whole distance, that is from Allahabad to Delhi, is next to a dead level, and that a gradient, rising not more than 1 in 2,000, can be obtained.

13. This most important object was kept in view on the late examination of the valley of the Ganges, and although it would be almost premature and rash to state so positively before regular sets of longitudinal sections are made, yet I have strong hopes, amounting almost to conviction, that a gradient not much, if at all, greater than 1 in 2,000 may be obtained all the way from Howrah *vid* Rajmehal to the River Soane on the West of the city of Patna, being a distance along the line of Railway of about 440 miles.

From the Soane to Allahabad the country is described as being of the same character as that further down the river, that is, rising uniformly about 6 inches in a mile.

14. I shall now endeavour to describe the course of the line, which I propose for your consideration, and its superior advantages will, I think, appear manifest as I proceed.

Avoiding the hill country altogether, on the one hand, and keeping clear as much as possible on the other of the inundated country on the right, or West bank of the Bhageeruttee, the Railway, as at present laid down, may be adopted as the main line from Howrah to Pundowah and Burdwan to a place between Boodbood and Caksa, about 25 miles West

of Burdwan, and nearly 100 miles from Howrah. By keeping on the colliery line to Burdwan, the object gained is having only one crossing of the Banka Nullah, which will be a large and expensive work, and no great detour is made, since Burdwan and Rajmehal are almost upon the same meridian line.

15. Leaving the colliery line near Caksa, the Railway would go in nearly a Northerly course, keeping West of Elam Bazar, and here cross the river Adjai; the channel of the river in low floods is about 800 yards wide, and in high floods covers an additional width of about 100 yards on the South margin, and 500 yards on the North margin. High floods rise somewhere about 16 or 17 feet. The soil is of sandy clay. At present there is only about 18 inches of water in the deepest part of the channel. The viaduct for crossing this river will necessarily be a very heavy work, but will no doubt be the heaviest required between Burdwan and Rajmehal, and there is nothing of an insuperable appearance about it, especially as the channel of the river is comparatively without water for eight months of the year, thus giving facility for carrying on the works. By going further up the river a better crossing may be obtained, but this is a matter for future investigation.

16. Proceeding Northwards the surface is of the same character between the rivers Adjai and Mor, a distance of about 24 miles: two nullahs are crossed; one flooded about 300, and the other 150 yards. Here the line would pass near Sooree, a considerable town and civil station about 3 miles South of the river Mor. This river is here about 700 yards wide between its banks, and in high floods covers about 300 yards more on its South margin, and 800 yards on its North margin. The soil is of the same kind as that at the Adjai, which river it resembles exactly, except that it is somewhat smaller and now carries less water. By going higher up the river a narrower crossing can be had.

17. The line will then proceed in a generally good direction on to Rajmehal, crossing several rivers and nullahs, of which the principal are the Dwarka, the Braminee, the Banslee River and the Goomanee Nullah.

18. On the North side of the Banslee some rock is found, and so continues more or less all the way to Rajmehal, but of this portion of the line I regret that, from want of time to make a minute personal examination of it, I am unable to say more than that the Railway may be continued along the base of the jungly hills, making such easy curves as will escape the inundations, and cross the rivers in as favorable places as possible.

19. About Rajmehal the hills are thickly covered with jungle, which extends some distance from their base. The selection of the best line will here require much care, as the hills are irregular and throw out spurs or promontories into the plain.

20. Keeping by the foot of the hills, the line will now bend to the North-West through a jungly country, but it soon becomes open again and the surface is quite level.

Passing Suckragully on the right, the line will bend more to the West, and cut through a low pass between an outlying hill at Gungapersaud and the main range. This is about 30 miles from Rajmehal. At Shahabad, the line should curve to the North some miles to avoid crossing some elevated land, and on to the civil station of Colgong, which is prettily situated on some rocky ground close to the margin of the Ganges.

21. At Colgong the hilly ranges recede from the river, and highly-cultivated rich country, of an open character, perfectly level, extends to the Westward as far as the eye can reach.

22. From this place the Railway should keep close to the Trunk Road on the left side of it by Goya, crossing two nullahs of no great size, and so on in nearly a straight line to the important town and civil station of Bhaugulpore, the country level and partially inundated; an embankment of about 5 feet will be required here. Bhaugulpore is about 268 miles from Calcutta.

From this place going in a North-West direction, the country maintains the same level character for many miles, several small nullahs must be crossed, slight embankments required.

23. Approaching Monghyr, the Curruckpore Hills appear running North and South; a bend must now be made to the right to reach this populous and commercial town.

24. Leaving Monghyr, the Railway will follow the curve of the River Ganges on the level ground between it and the hills, crossing a nullah about 6 miles from Monghyr.

25. The land is said to be partially inundated. About 28 miles, from Monghyr the line will cross the Dunneah or Mahance River, and here a large bridge will be required. The river is said to be nearly half a mile wide in the rains, but of no great depth; only a very cursory view could be had of this river, and a more minute examination must be made before reaching any satisfactory conclusion as to the best place and manner of crossing it. The River Mahance runs nearly

parallel with the Ganges at a distance of 3 to 5 miles from it. For a distance of about 60 miles, the intervening strip of land is highly cultivated and populous, and is dotted with many large villages and is in general, so far as we could learn, out of the reach of the inundations. No bridges will be wanted on this length, and very few culverts.

26. Approaching Patna a small river is crossed, where a good bridge will be required.

27. The City of Patna is distant 408 miles by dak road from Calcutta.

28. Twenty-five miles West of Patna, the dak road to Benares, after passing the large Military station of Dinapore, adjoining Patna, crosses the River Soane at Sooranah Ghât, which is about 6 miles from the confluence of the Soane and the Ganges. At this place, the River Soane has two channels, the first one is 374 yards wide, and 15 feet deep, and is at present quite dry, the other, and larger channel, is about 1,100 yards wide, with well-defined clay banks, and the depth of water in the middle is about 5 feet. The two channels thus possess an aggregate breadth of nearly 1,500 yards, which contain the water in time of floods.

The width of this river at the place where the Grand Trunk Road crosses, is in time of floods about  $2\frac{3}{4}$  miles, or more than three times the width of the river near Patna.

29. On the banks of the River Hooghly, we find the surface of the land to be on a higher level than it is some miles distant from the river; the banks of the Ganges seem in general to be in the same condition; the country is flooded in the interior, whilst on the banks of the great rivers, the land is often free from inundations. This may be accounted for by the rivers in high floods depositing the greater portion of the suspended mud and fine sand immediately that the velocity of the current is checked by its overflowing the river banks, and thus the land in the vicinity of the rivers keeps rising faster than the interior, and it is more than probable that the beds of the great rivers are rising likewise. This accounts for the channel of the Soane being narrower near its confluence with the Ganges, as here it has in a manner to force its way through the bank of the latter, and is prevented from spreading by the superior elevation of the land.

30. The above would indicate the best place for crossing the river to be near where it falls into the Ganges, but to ascertain this important point, a much closer and more minute examination of the river



will be necessary. I am informed there are rocks on each side of the river at Rotasghur, but that place is many miles up the river and would not answer for a line carried by way of Patna.

31. I do not enter on the subject of bridging the Soane at present, as no data sufficient for that purpose are in existence so far as I know ; but as it is of vital importance that the Railway should touch Patna, under any circumstances, I think there can be no question of the propriety of the recommendation to carry it there as soon as arrangements can be completed, and there I would stop, as it would be premature to do more until the country from Patna to Benares and Allahabad has been examined with a view to a Railway, and the best place and manner of crossing the Soane be found out, which latter may be effected by a pontoon bridge, a steam-ferry, or a permanent Railway, as cost and other circumstances point out.

32. Having thus pointed out the proposed route of the Railway, I shall now, as briefly as possible, mention some of the advantages to be gained by carrying it on this line.

33. On reaching Rajmehal it is admitted on all hands, that there will be a large accession of traffic, as the shutting up of the Bhageeruttee in the dry season will be provided against, and the circuitous navigation of the Sunderbunds saved. The Ganges has often with much propriety been called the great thoroughfare or highway for the produce of the country, but its navigation is bad for the greater part of the year, slow, uncertain and impeded by shoals and sand-banks. This will in a great degree be provided against by carrying the Railway as near as may be along the banks of the river touching Colgong, Monghyr, Bhaugulpore, Patna and Dinapore.

34. With few exceptions the line may be said to pass through a fertile, well-cultivated and populous country, containing many large towns and villages.

A considerable trade in grain and other commodities is carried on, but its development is crippled, for want of roads and means of communication.

35. If the Railway were carried to Patna, the indigo produced in Purneah, in the district of Bhaugulpore, in the provinces of Behar and Tirhoot, and probably Benares, would be conveyed upon it to Calcutta with expedition and safety, as well as profit. Also sugar, saltpetre, raw silk, piece goods, drugs, dyes, and a variety of miscellaneous articles.

Patna is a great mart or emporium for the produce of the country: it contains about 4,00,000 inhabitants, and is nearly 6 miles in length. An intelligent merchant of this city mentioned as an example of the extent of trade done here, that raw cotton to the value of 40 or 50 lacs of Rupees was annually brought from the Upper Provinces and sold to Patna merchants. The extent to which trade in wheat, gram, and other kinds of grain is carried on is very manifest; the shores of the river are lined with the country cargo boats for some miles opposite the city, taking in and delivering cargoes.

36. More details can be given, but I do not think it necessary to go into them at present, as I trust that the superiority of the river route will be admitted. I have only to add that its advantages over the other as a "paying line" of Railway are to me so apparent after seeing both routes, that I would have recommended the adoption of the Ganges line, even although the other had been on a dead level all the way from Calcutta to the River Soane.

37. If it should be determined to carry into effect the above-described great work, it is highly desirable that an estimate of it should be made without delay, and nothing approaching to an accurate estimate can be made until the country is closely examined, levels taken in every direction, and longitudinal sections taken, and the gradients laid down on them for the whole 360 miles from near Burdwan to Patna and the River Soane.

38. Judging from what has been accomplished during the cold season just over by my two assistants, Messrs. Purser and Evans, who have, under my inspection, set out and taken the section of about 95 miles of Railway from Pundowah to the Collieries, it appears that a good engineering surveyor can accomplish about 40 miles of Railway, as regards selection, clearing the centre line, setting out and levelling, so that should it be determined to have even an *estimate and section* of the proposed line to Patna, I should require to have no less than *nine* experienced engineering surveyors ready to take the field in October of the present year.

39. Of course this is altogether distinct from the staff necessary to make the surveys for getting possession of the land.

This latter is a most tedious and intricate business, on account of the extreme sub-division of holdings in Bengal, which must all be exhibited, and gives an amount of labour per mile quite *four times* as much as such property plans usually require in England.

40. Although it may be stepping beyond the immediate subject of this Report, I cannot avoid alluding to the possibility of connecting the East Indian or Calcutta and Delhi Railway, with the Western or Bombay side of Hindoostan. The advantages to be derived from such a connection require no comment: the magnitude of the subject demands that it be approached with the utmost caution, and it is with due submission to your judgment, and to that of the India Board, and the Government of India, that I venture to suggest, as a preliminary step, that a series of trial levels should be taken from Benares or rather from Patna to Bombay.

41. By inspecting the Map of India, it will be found that the River Soane, a large tributary of the Ganges, joining the latter near Patna, the Nerbudda, which sheds its waters into the Indian Ocean on the West side, and the great River Godavery, which falls into the Bay of Bengal about — miles north of Madras, all find their sources near each other. If the East Indian Railway on the one hand, could be extended up the valley of the Soane, and the Bombay Railway, on the other hand, carried up the valley of the Taptee or Nerbudda to a point of union, so that a descending line with easy gradients could be established from such a point down either the valley of the Taptee, or that of the Nerbudda to Bombay, down the Godavery line to Madras, and down the Soane and Ganges line to Calcutta, the advantages would of course be great; until the engineering practicability of this be ascertained, no opinion can be offered as to whether it be desirable to carry it into effect.

To ascertain the facts of the levels and practicability of a Railway in such a direction, would not be difficult nor expensive. I am willing to undertake the work, if the means of doing so are placed at my disposal, and I do not think that more than a period of 12 months would be necessary for taking the trial levels and sections of the whole and laying it down on paper, on a scale of about 1 inch to a mile.

I have the honor to be, &c.,

(Signed) GEO. TURNBULL.

FROM MAJOR J. P. KENNEDY,

*Consulting Engineer to the Government of India,  
Railway Department.*

TO F. J. HALLIDAY, ESQUIRE,

*Secretary to the Government of India,  
Home Department.*

CALCUTTA, FEBRUARY 27TH, 1851.

SIR,

IN reference to paragraphs 21 to 54 of my Report, dated 29th ultimo, I have the honor to report that on the 9th instant, I left Calcutta, and having joined Mr. Turnbull, the Chief Engineer to the East Indian Railway Company, at Serampore, we proceeded together, accompanied by Mr. D'Cruz, Surveyor, to examine the comparative merits of the Ganges and direct lines, preparatory to offering any final opinion as to which should be the route for continuing the Railway from Calcutta to the North-West Provinces. We proceeded by Rajmehal, Monghyr, Patna, &c. to the confluence of the Soane with the Ganges, and returned over the chain of hills by Dunwa to Burdwan.

2. I had already obtained much information regarding the district lying between the river Hooghly and Rajmehal, both by personal communication with Colonel Forbes, and from his valuable Report and Survey of that district.

3. The comparison of the levels on the competing lines, and the general effect of that question as regards the future revenues of the Railway Company, I dwelt upon sufficiently in the paragraphs above referred to in my former Report on this subject.

4. The engineering difficulties, I conceive, would be very much less by the Ganges than by the hill route, the width of the formidable river Soane being little more than  $\frac{3}{4}$  of a mile at the point where it would be passed on the Ganges route, whilst it is nearly  $2\frac{1}{2}$  miles wide at the point of passage proposed on the direct or hill route.

5. The great commercial advantages to the public, as well as the financial advantages which must accrue to the Railway Company, by the adoption of the Ganges route, will be at once understood by any one who will take the trouble of visiting the whole of the district as I have just done. He will find the Circular Canal at Calcutta, the terminal harbour for Ganges traffic, so crowded by arriving and departing boats

of considerable burden as completely to cover and block up that extensive canal.

He will find numbers of boats with their cargoes laid high and dry on the shallow banks of the Bhageeruttee River.

He will perceive the broad waters of the Ganges from every point of view as he ascends that river, and as far as the eye can reach, covered with fleets of laden boats, with their crews toiling towards their different points of destination against the most adverse circumstances.

And finally, he will be hailed by an enthusiastic and universal welcome from merchants, manufacturers, and producers of every class in any proposition that he can make calculated to remove the risks, to shorten the time, or reduce the painful labour, cost, and uncertainty which now attend their efforts to bring the produce of their districts into any market.

No man who makes this tour will have a doubt as to the enormous extent of the Ganges carrying traffic, nor as to the vast impediments which at present oppose its success. He will be struck with admiration at the persevering and courageous exertions of those enterprising men who dare to face such impediments, and he will be convinced of the enormous public benefit, as well as the private advantages, which must attend the removal of these impediments, by laying a line of Railway along this great commercial artery of India.

And as the traveller turns in his course to examine the competing line through the hills, he will find that the Gangetic train will answer every purpose; that every hackery load of produce now travelling along the road must necessarily drop into the Company's trucks, and that neither public inconvenience nor private loss can attend the withholding of a Railway from the desert hill district in question.

6. It is upon these grounds, in addition to the grounds put forward in my Report of 29th January last, that I venture, with the utmost confidence and earnestness, to recommend the extension of the East Indian Company's Railway by the route of the Ganges, and not by the direct hill route.

7. If the Government should agree to my recommendation of adopting the Ganges line, I believe that the East Indian Railway, with its extension into the North-West Provinces, will, when completed, form the most perfect work of the kind in the world. Throughout the whole of that immense distance, there will probably be no gradient above 1 in 2,000 to limit the load of an engine. In fact, the first undulating

ground to be encountered in this line will be in the neighbourhood of Rawul Pindee, nearly 1,500 miles distant from Calcutta.

8. This point, if settled, will leave nothing to interfere with the earnest desire of the Government for a vigorous and immediate extension of Railways, which they so justly regard as an essential preliminary to every other improvement in India, annihilating as it were distance, and reducing the inconvenience and evils of climate.

9. The regulations and principles already laid down by Government are such as must secure economy, both in the first construction and in the after-working of the line, and therefore, I feel justified in recommending, in the full spirit of the views entertained by Government, the most rapid extension of the works. This may either be, by putting the force on so as to open from Calcutta continuously, or by working simultaneously to the North-West from Mirzapore as a second point.

10. The present very efficient establishment of the East Indian Railway Company, whether as regards its general agency, its Accounts Department, or its Engineering Department, is a matter not to be overlooked when considering the anxiety of the Government of India to extend to the industrial classes of this vast empire, the power of commercial intercommunication, and of reaching markets with their produce.

This establishment, which might be considered as very large and perhaps disproportionate to a small undertaking, is perfectly in character and fully equal to the duties demanded by an enterprize extending to 1,000 miles.

11. The line has now been set out as far as Raneegeunge, and the officers in charge of the East Indian Railway Company's works are proceeding to prepare the survey and longitudinal section of the line to that point, as well as the working drawings of all the works required upon it, so that there may be as little delay as possible in calling for tenders with a view to commencing the works vigorously immediately after the rains.

12.- I should propose that an authority be given to the Railway Company's officers to adopt measures, with the least possible delay, for obtaining the requisite preliminary levels and surveys of the whole extension of the line by Rajmehal, Patna, and Mirzapore, as far as Delhi, as well as the important branch by the valleys of the Soane and Nurbudda or Taptee, which, meeting the Bombay line, will hereafter connect the two Presidencies of Calcutta and Bombay. Such early

preparation and investigation are most essential, both as regards the future economy and the perfection of the works, and the interval between this and the ensuing cold season, if promptly availed of, will admit of the necessary arrangements being made and assistance obtained, by which the Government may secure the early accomplishment of this most desirable object.

13. I have lost no time in acting upon the authority contained in your letter, No. 166, of 14th February, and have taken measures with the Agent of the East Indian Railway Company for the immediate assembly of a class of surveying students.

14. The great question of how the Rivers Soane, Jumna, &c., are to be made passable, demands that an earnest attention should be at once given to those subjects which bare upon it. In this respect the timber question is one of very great importance and merits the closest consideration. The strange anomaly exists here that we are carrying on works in a country producing large quantities of the finest qualities of timber to be found in the world, whilst the defective principles on which it is brought to market must limit its use and increase injuriously its cost. Nor have experiments as to its preparation against rapid destruction been yet carried to an extent that would justify its application to the larger and more costly structures, even if it could be provided at a reasonable price. There is great difficulty in obtaining the requisite supply even of the minor scantlings suitable for sleepers.

It appears desirable that the Government should obtain as much information as possible, from their various agents in the timber producing districts, as to the causes which now prevent the copious and economical supply of that important article.

It would likewise be very desirable that an extensive and varied set of experiments on the preparation of timber against decay, should be at once instituted. I am aware that Mr. Turnbull has some experiments of this class at present in progress.

The principle of passing trains over large rivers or estuaries upon rafts, is now practised in some instances in Europe, and is well worthy of attention from those charged with Railway construction in India. I shall seek, after my arrival in England, to furnish the Indian Government with a statement of the present progress which this principle has attained at home. In the meantime I think it would be inadvisable to undertake any work in reference to the immediate passage of those large rivers. It would be sufficient to consider for the present those

points as temporary termini for the lines reaching them from either side, until the traffic demands more perfect means of crossing the rivers, either by floating rafts, by bridges, or otherwise, by which time it is probable that those important elements, which I now refer to as immature or not forthcoming in aid of such works, may be perfectly available.

15. It is with the greatest possible satisfaction I have learned, that the Hon'ble Court have sanctioned the enlargement of the general Indian guage from 4 feet 8½ inches to 5 feet 6 inches, and I trust I may be excused in proposing the still further enlargement of the guage to 6 feet, as recommended by the Most Noble the Marquis of Dalhousie. If the Hon'ble Court will permit the reconsideration of this very important question, and allow me, in concert with any one or more professional men, whom they may select, to offer them a report on the subject, I think that such a report may be submitted within a very few weeks after my arrival in England next April. This could cause no inconvenience or delay whatever, either as regards the works in progress in Bombay, or in Bengal, and it cannot fail of being satisfactory to the Hon'ble Court to be furnished with such a document in reference to a most important and disputed question, which has not yet received that professional investigation that it merits as regards Indian interests. It is a question that can only now be considered with profit, as if an error be introduced, it will be beyond the reach of future remedy.

16. Although I have strongly urged the necessity of constructing all lines in India in the first instance for single tracks, I look forward confidently to the conversion of many to double tracks afterwards.

After a line opens, I would recommend that only one train daily in and out be started at the commencement. When more goods are offered than an engine can carry by one train, then and not till then a second train daily might run. And when the demands of commerce completely fill two daily trains, and call for a third, this I should consider ample proof that measures were required for furnishing a second track.

There is one point I must refer to in connexion with the works of Railways intended in the first instance for carrying single tracks, with the power of future conversion to double lines. This is where any foundations for bridges or other works are constructed that require piling. In all such cases, I should advise that the piling and founda-



tions be completed for the double track, as I should not like the risk of re-opening or disturbing such foundations by any second operation of driving piles close to the previously constructed work. The works will therefore be constructed on the following principles :—From Howrah to Pundowah, the earth-works, bridges, masonry, &c., will be prepared for a double line, the ballast and permanent way for a single line only being at first laid. All further extensions should be limited at first to single lines, with the qualification above referred to in respect of bridge foundations.

17. With reference to the suggestion for a branch line from near Burdwan to Culna, the general tenor of my present Report, and the line recommended, will show that such a branch will not be required, as the object had in view by the Court of Directors in that suggestion will have been otherwise amply provided for.

18. I should recommend all road crossings to be upon the level until the second line of rail is found to be required.

I have the honor to be, &c.,  
(Signed) J. P. KENNEDY, *Major,*  
*Consulting Engineer to the Govt. of India,*  
*Railway Department.*

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FROM MAJOR W. E. BAKER,  
*Consulting Engineer to the Government of India,*  
*Railway Department,*

TO F. J. HALLIDAY, ESQUIRE,  
*Secretary to the Government of India,*  
*Home Département,*  
*Fort William.*

CALCUTTA, 19TH FEBRUARY, 1852.

SIR,

I now beg to report, for the information of the Most Noble the Governor General, the progress I have made in the course of my late tour, in ascertaining the facilities for future extension of the Railway. With this view I have examined the country from Burdwan to near Colgong, on the Ganges, and from Raneegunge to the confluence of the Barrakur and Damooda.

EXTENSION OF THE COLLIERY BRANCH.—2. There is no important physical obstacle to the extension of the colliery branch from Raneegunge towards the Barrakur coal-fields. It would cross two inconsider-

able streams, the Noonea, and the Talkooreeka Jour, and many nameless ravines, but no extensive works would be required, and rock foundations would, I believe, be generally met with.

ITS COURSE.—3. The line which I would recommend for the first trial section, would, after passing Raneegunge, follow the left bank of the Noonea for about 3 miles before crossing that river. It would thence pass obliquely into the valley of the Damooda, and by keeping parallel with its left bank, at a distance of a quarter to half a mile, it would avoid the broken and undulating ground which so strikingly characterizes that tract of country, and which is exhibited in the profile of the Grand Trunk Road.

ITS PROBABLE COST.—4. The distance from the point at which the Railway works are now stopped, to the banks of the Barrakur River, is about 23 miles. The work per mile, adapted in all respects for a single track, would not exceed in quantity that on the Raneegunge line, and on a moderate contract would not cost more than 55,000 Rupees per mile, exclusive of rolling stock.

ITS CONTINGENT VALUE.—5. The expediency of this extension appears to depend entirely on the character of the Barrakur coal, which unless of superior quality, could not compete on equal terms with the inexhaustible supplies of Raneegunge and Mungulpore, situated 23 miles nearer the market. Professor Oldham, Superintendent of the Geological Survey, who is now examining the coal-fields, has promised me early information regarding the value of the different beds, and I await his report before making any specific recommendation regarding the prosecution of this inquiry.

EXTENSION OF TRUNK LINE, GENERAL REMARK ON THE FEATURES OF THE GANGETIC VALLEY.—6. Before entering on the more important subjects connected with the extension of the Trunk Line of the Railway towards the North-Western Provinces, I would beg to offer a few preliminary remarks on the general features of the Gangetic valley, and to refer, in illustration of them, to the accompanying sketch map. The rocky range of hills which terminates at Rajmehal and deflects the Ganges for upwards of 300 miles from its proper South-Easterly direction, necessarily prescribes in a great measure the course of a Railway through the valley of that river, and while on the one hand, it fixes a limit within which the works will be secure from the encroachments of the stream, on the other, it causes a considerable detour from the direct line, and entails many difficulties, and consequent increased expenditure.

But the circumstance which has most materially modified the topography of the valley, is the tendency of this, as of all other rivers charged periodically with the detritus of high lands, to raise its own margin, and thus form a natural barrier to the entrance of lateral drainage. Where the hills West of Rajmehal approach nearest the river, they are found to be separated from it by a strip of land, varying in width, consisting chiefly of jheels and swamps, with intervening low, rocky ridges, and bounded towards the river by a mound of higher land, along which, though subject to annual inundation, the Post-road is now carried. These jheels receive both the hill drainage and the overflow of the river, and find a partial vent through a few shifting and circuitous channels, south of Rajmehal. As the hills recede from the river, and as their drainage increases in importance, the peculiarity above alluded to is more strikingly exemplified. The Rivers Braminee, Dwarka, Mor and Quera, as they approach the Ganges, are deflected from their Easterly direction into a course parallel with the Bhageeruttee, into which their accumulated waters finally force an entrance. The same difficulty is experienced by the Kurree and Banka Rivers, and even by the powerful Damooda, which, forced to abandon its direct communication with the Hooghly at Muggra, now finds its way into that river, 30 miles below Calcutta.

LEVEL ROUTE BY THE RIVER BANK.—7. There are, therefore, two courses by which a Railway might be taken, so as in some measure to avoid the confluent inundation of the hills and the Ganges;—*first*, by following the elevated margin of the river on an embankment raised above the level of the highest floods, and with copious openings for the flux and reflux of the inundation, according as that of the hills, or of the river might prevail. This line, which would, in fact, be an extension of the present one from Muggra onwards, might be carried nearly on a level, would perhaps be the less expensive in its first construction, and would afford frequent opportunities of communication with the river traffic. But the foundations of the large masonry works would be insecure, and the line itself would be liable to interruption by the encroachments of the river, whose changes are too capricious to be calculated upon with any certainty. The last-named objection alone is in my opinion conclusive against this course.

ALTERNATIVE ROUTE SKIRTING THE HILLS.—8. The alternative, and in my judgment, the preferable line, would separate from the present one at a point West of Burdwan, beyond the inundations of the Da-

mooda, and of its offshoot, the Banka Nulla. It would then proceed in a Northerly direction, crossing the Adjai near Soopore, and the Mor about 10 miles East of Soory (Beerbhoom.) It would thence turn slightly to the Eastward, and passing East of Nulhattee, would skirt the base of the hilly tract as far as Colgong, on such a level as would be above the highest inundation, and at a safe distance from the possible encroachments of the Ganges. A contour line exactly fulfilling these conditions would, however, be a very circuitous one, on account of the projecting ridges and intervening valleys, but I am satisfied, from personal examination, that a line may be found, by which good curves and gradients may be secured, without any extraordinary expense, for embankments and rock cuttings.

COMMUNICATION WITH RIVER TRAFFIC.—9. The route I have described would pass 3 miles West of Rajmehal, which is of the less consequence, as that town is not now accessible by steamers in the dry weather. The present proximity of the navigable channel of the Ganges to Oodwa Nulla, appears to indicate that point as a favorable one for the first communication between the Railway and the river. A second might be established at Colgong. It appears advisable, however, that the goods stations on the river bank should be of a temporary description, and should be constructed of such materials as could be easily transported from one place to another to suit the frequent changes of the navigable stream.

COMPARATIVE LENGTH OF THE TWO ROUTES.—10. By the alternative route the distance between Howrah and Rajmehal (or Oodwa Nulla) would be increased by about 18 miles, but the length of *New Railway* required to connect the two places would be 35 miles less than by the route first described.

ROUTE THROUGH THE DAMUN-I-KOH, PROPOSED BY CAPTAIN SHERWILL.—11. It was suggested to me by Captain Sherwill, of the Revenue Survey, from whom I derived much valuable information, that the difficulties to be encountered in rounding the hills in the vicinity of Rajmehal might be avoided by the adoption of a shorter line through the Damun-i-koh, and which entering that district near the village of Muhobutpore, would follow the valley of the Gomanee and its tributaries, and crossing a low ridge between Burio and Meghi, would proceed by the valley of the Coa to Colgong. After such an examination of the country as I was enabled to make without the aid of levelling instruments, I feel no doubt that a Railway could be constructed on the proposed line. It would involve one deep cutting, and one tunnel of about a

mile in length, both probably through rock, but the greater part could be constructed at very little expense. The diminution of distance, and the avoidance of serious difficulties between Oodwa Nulla and Colgong, are circumstances strongly in favor of this line, but I can scarcely hope that the gradients would be such as I could recommend for the Trunk line of the East Indian Railway. A trial section should be taken as soon as possible, and every facility for it would be afforded by the general clearance of jungle on the level grounds, which are highly cultivated, and by the excellent cart roads which traverse the district. In both these respects the Damun-i-koh presents a striking contrast with the bordering pergunnahs to the Eastward and Northward.

**TRIAL SECTION OF THE RAJMEHAL LINE GRADIENTS.**—12. The trial section actually taken by the Railway engineers, extends from near Surrool on the Trunk Road, to Oodwa Nulla on the Ganges. It exhibits considerable undulations in the level of the country, which will involve both ascending and descending gradients. The line first selected for examination may be greatly improved in setting out the Railway, and there is every reason to suppose that a ruling gradient of 1 in 1,000 will be attainable without entailing heavy works.

**VIADUCTS OVER THE PRINCIPAL RIVERS.**—13. The chief source of expenditure will be the construction of the bridges required over numerous rivers and water-courses. The Rivers Adjai, Mor, Dwarka, Braminee, Banslee and Goomanee must be crossed on alluvial soil where their channels, though well-defined, are liable to enlargement by the erosion of the banks. The soil in the river beds consists superficially (and probably to a great depth) of sand and fine gravel. The general character of the streams strongly resembles that of the rivers which drain the Sub-Himalayas in the North-Western Provinces, and the description of foundations which has there proved successful in the canal works, would probably answer equally well for the Railway bridges. From data obtained on the Ganges canal works, I have calculated that a continuous solid platform of brickwork, of depth and strength sufficient to resist the floods, and of width to carry superstructure for a double track, may be laid across the Rivers Adjai, Mor, &c., for 500 Rupees per yard forward, whereas a piled foundation, though not affording so good a security against the scouring action of the current, would be greatly more expensive.

**ESTIMATE OF THE PROBABLE COST OF THE RAJMEHAL EXTENSION.**—14. The length of the Rajmehal (or Oodwa Nulla) branch would be about 120 miles, nearly the same as that of the line now under contract, and

the cost of the former ought certainly not to exceed that of the latter. In the absence of precise data (for I have not yet received a copy of the section taken by the Railway engineers) my estimate of the cost of the new line is based on a comparison between it, and the one now in progress, except as regards the foundations of the large viaducts.

The earth-work on the Rajmehal line would be less in quantity, but in consideration of probable rock-cutting, may be reckoned at an equal cost.

The brick, iron, and timber-work in bridges, culverts and flood-openings, would be lighter on the new line, notwithstanding the greater magnitude, and more formidable character of the rivers. I estimate them both as follows :—

*Howrah to Raneegeunge.*

|                                                                |           |
|----------------------------------------------------------------|-----------|
| Bridges, 1,029 yards at 800 Rupees per yard forward, ...       | 8,23,200  |
| Culverts and flood-openings, 6,690 yards, at 300 Rupees ditto, | 20,07,000 |

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Company's Rupees 28,30,200

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*Rajmehal Extension.*

|                                                                |           |
|----------------------------------------------------------------|-----------|
| Bridges, 1,600 yards, at 1,000 Rupees per yard forward, ...    | 16,00,000 |
| Culverts and flood-openings, 2,000 yards, at 300 Rupees ditto, | 6,00,000  |

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Company's Rupees 22,00,000

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Showing a saving of 6,30,000 Rupees.

In the cost of ballast considerable saving may be effected on the new line. In the present contracts this item alone amounts to Company's Rupees 14,67,160, but on the new line, natural ballast may be obtained at less than one-third of this cost.

The price of the permanent way materials may be taken as the same in both cases, but the cost of laying them would be greater on the new line, owing to the greater distance of carriage.

The cost of stations would be less on the new line, as it would not include an expensive terminus.

The cost of engineering and management would also be less, owing to the salaries of the Chief Engineer, the Managing Director, and others being divided over a larger field of operations.

On these data, I have framed the following estimate:—The bridges, &c., being calculated for a double line of Rails; the earth-work ballast and permanent way for a single track.

|                                        |                      |
|----------------------------------------|----------------------|
| Earth-work, .. .. .                    | 10,000 Rs. per mile. |
| Viaducts, Culverts, &c., .. .. .       | 19,000               |
| Ballast, .. .. .                       | 4,000                |
| Laying and Maintenance of Way, .. .. . | 6,000                |
| Materials of Permanent Way, .. .. .    | 20,000               |
| Stations and Apparatus, .. .. .        | 4,000                |
| Surveying and Engineering, .. .. .     | 1,000                |
| Direction and Management, .. .. .      | 3,000                |
| Sundries, .. .. .                      | 3,000                |

Total per mile, Rupees, 70,000

or for 120 miles, Company's Rupees, .. 84,00,000

Exclusive of Rolling stock.

COMMERCIAL ADVANTAGE OF A RAILWAY TO RAJMEHAL.—15. The portion of Railway which connects the Port of Calcutta with the head of the Ganges delta, is not only an important section of the Trunk line to the North-Western Provinces, but will in itself exercise a great influence on the trade of the country. It cannot be doubted that the more valuable portion of the river traffic, which now finds its way through the winding creeks of the Sunderbunds, or the shallow channels of the Nuddea Rivers, would preferably be conveyed by the more secure and expeditious means afforded by a Railway. Every step of further progress, and especially the completion of a line to the great emporium at Mirzapore, will add greatly to the commercial value of the whole undertaking, but the section now under review is certainly not the least important link in the chain of communication.

INTERMEDIATE TRAFFIC.—16. The Rajmehal Railway would chiefly depend for its traffic on the Ganges, but it may fairly be expected that yearly increasing returns would be derived from the intermediate trade. The mineral resources of the country, which are considerable in coal, iron and other metals, would be rapidly developed by the increased facilities of transport.

17. I would merely remark, in conclusion, that the sooner the Rajmehal section is completed, the sooner may we look for adequate returns on the capital now being invested in the "experimental" section, which by itself may probably not be remunerative.

I have the honor to be, &c.,

(Signed,) W. E. BAKER, *Major,*  
*Consulting Engineer to Government of India,*  
*Railway Department.*

REPORT No. 5.

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EAST INDIAN RAILWAY,  
RAJMEHAL EXTENSION.

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TO THE CHAIRMAN AND DIRECTORS OF THE EAST INDIAN  
RAILWAY COMPANY.

SERAMPORE, 23RD FEBRUARY, 1852.

GENTLEMEN,

IN anticipation of the sanction which has been granted for the survey of an extension of the Railway towards the North-West Provinces by way of Rajmehal, I proceeded, in company of Major Baker, the Consulting Engineer to the Government of India, and my assistant Mr. William Evans, and in the months of December and January last, we effected an examination of the country between Burdwan on the South, and the shores of the river Ganges near Rajmehal.

2. In the general result of this investigation, it was found that a line of Railway might be selected, with easy gradients, and without any heavy amount of cutting or embanking, and without any formidable works except at the river crossings, to be hereafter described, extending from a point near Burdwan, to a spot on the right bank of the Ganges near Rajmehal.

3. Having decided upon the line on which it seemed most advisable that a trial section should be taken, I left Mr. Evans instructions to proceed, and commencing at Rajmehal, he, by means of great exertions, completed a set of levels, and longitudinal section of 118 miles in length, terminating on the line of Railway now in course of construction near Burdwan. I have the satisfaction to lay before you the longitudinal section alluded to, and also a plan, showing the proposed course of the extension to Rajmehal.

4. I shall now proceed to describe the course of the line as succinctly as possible. From the commencement at Howrah to the point where this extension line will diverge from the line now in course of construction, the distance is about 81 miles, and the distance thence to the



Ganges at Rajmehal is 118 miles, making the total length from Howrah to Rajmehal 199 miles.

5. A ruling gradient of 1 in 1,000 has been adopted, and the gradients laid down on the section are nowhere in excess of it, but it is to be borne in mind that when embankments and cuttings are described, they may be lightened, if necessary, by adopting a less favorable gradient, and also that the present being only in the nature of a preliminary or trial section of the country, it is more than probable that considerable improvements can be made on a more minute investigation; but on the other hand when we consider the low price for which we may expect to get the earth-work performed, it will not be found advisable to add much to the length of the line, by making it circuitous to avoid earth-works.

6. The point of divergence alluded to above, is about 15 miles West of Burdwan, near the village of Koorkoorpore. Here the extension line will bend to the Northwards, with an easy curve of three miles radius, and then proceed almost due North for about 41 miles to the place where it will cross the river Mor: passing the village of Dusgaon on the right, Elam Bazar about  $6\frac{1}{2}$  miles on the left, Surrool about  $\frac{3}{4}$  of a mile on the right; and the large town and civil station of Sooree about 7 miles on the left.

7. The surface of the country is gently undulating, and the line will cross several streams besides the river Adjai. The first of these is the Kurree Nullah, which is about 60 feet wide, next is the Kumnoor Nuddy, about 130 feet wide, then comes the crossing of the large river Adjai. Across the valley of the Kumnoor an embankment will be necessary, about 4 miles long and nearly 17 feet high.

To obtain a gradient of 1 in 1,000, some cutting will be required North of the Kurree Nullah, the greatest depth of which will be 27 feet. By keeping some miles to the Eastward, less earth-work would be necessary, but this could only be done by lengthening the line of Railway, and making the junction nearer Burdwan. Future investigation will determine whether the additional length of Railway will not more than counterbalance the expense of the earth-works on the straight route.

8. The soil for the whole of the distance of 19 miles up to the Adjai is the ordinary alluvial clay of Bengal, with considerable beds of limestone, kunkur and sand as we approach the Adjai. This limestone, kunkur or gooting is an excellent material for ballast.

9. The crossing of the river Adjai will be a formidable work. In the dry season the river is only about 70 feet wide, and about 1 foot in

depth at the crossing, but in the rainy season it comes down with great force and fills a channel 1,450 feet wide, and about 16 feet deep, and the stream is said to be rapid.

The bed of the river consists of sand of an unknown depth resting on the alluvial clay. The whole of the 1,500 feet will require to be bridged, and the work will be expensive, and will be attended with some difficulty. The mode of construction most suitable will probably be that of sinking large masses of brick-work in the sand, removing the sand through perforations or wells left in the brick-work, according to a peculiar method, which, I am informed, has been attended with great success in carrying the Ganges canal across the sandy beds of rivers in the North-Western Provinces.

10. North of the Adjai the surface of the country rises rapidly for about three miles, then sinks again into the bed of the river Culpee.

This ridge is known as the Surrool ridge, and the line will pass through it close to the village of Surrool on the West side thereof. It is composed chiefly of a mass of sandy materials mixed with red ironstone, kunkur, and quartz, gravel, and pebbles. It is cut into many small gullies by the rains.

The greatest depth of cutting in the ridge will be 21 feet. Some trial levels have been taken East and West of the line near Surrool, and it is expected that an improvement may be made on more minute examination at this place.

11. The Culpee Nuddy is in the dry season a very small stream, only about 30 feet wide, and 6 inches deep, but during the rains it fills a channel 190 feet wide at the place of crossing, and the Railway will be about 27 feet above the bank, and 36 feet above the bed of the river. The soil is here similar to that of the Surrool ridge, and will afford a solid foundation for the brick-work of a bridge, provision being made to prevent the floods from scouring the bed of the river.

12. About 8 miles North of the Kulpee, occurs the Backersal Nuddy, the intervening space is composed of clay and limestone kunkur; the ground slightly undulates, and the works will be light. The Backersal is about the same size as the Culpee Nuddy. The channel, which is filled during floods, is about 198 feet wide. The line will cross it on a bridge 26 feet above the bed of the river.

Good brick clay is to be found plentifully in this neighbourhood.

13. From the last-mentioned Nuddy to the river Mor, the distance is about 9 miles; the country here is almost level, with the exception of a 20-foot bank over a small stream; the works will be very light, and the

Railway will be partly level, and partly on a gradient of 1 in 1,000. The soil is ordinary alluvial clay and kunkur limestone.

14. The Mor is a large river, similar to the Adjai in many respects. In the dry season the stream at the point of crossing is about 9 inches deep, and about 100 feet wide. During the floods it fills a channel 1,300 feet wide, and overflows its North bank about 18 inches in depth. There is a small artificial bank or bund on the North side, the South side is not bunded at this place. The point of crossing will be about 7 miles East of the town of Soory. The Railway will cross the river about 23 feet above its bed, and at this level it will be clear of the floods.

15. The bed of the river consists of sand, of which the thickness is not ascertained. On the South side red-iron kunkur is plentiful. It is a good material for ballast. The North side is composed of ordinary clay with beds of sand. The manner of constructing a bridge or viaduct, which will be about 1,400 feet in length, across this river, will probably be similar to that at the crossing of the Adjai.

16. After crossing the Mor the line proceeds nearly straight to the river Dwarka, descending at the rate of 1 in 1,000; the distance is  $4\frac{1}{2}$  miles, the ground is favorable, with a 15 feet bank, and a 12 feet cutting, crossing the Kandoor Nuddy, where a small bridge will be required.

17. The river Dwarka runs in a sandy bed, the thickness of which is not known, between steep banks of sandy clay. It is a small stream in the dry season, but that comes down with considerable force in the rains, filling a channel 350 feet wide. The Railway will here cross the river on a bridge at a level of 14 feet above the river banks.

18. It then comes to the right in a North-Easterly direction towards the village of Mullarpore on a level for three miles, then descending 1 in 1,000 for 5 miles, curving to the right again, and proceeding in a straight line Northwards, crosses the Moonra, the Chilla, and the Sangatta Nuddies, each of which is about 50 feet wide, on to the River Braminee, which will be crossed at the village of Jugdhuree.

19. From the Dwarka to the Braminee, the distance is  $21\frac{1}{2}$  miles, the works are of a light description. From Mullarpore to the Braminee, the Railway will be on a level for about 12 miles. The highest bank is 24 feet at crossing the Nuddies; on the remainder of this length the works are very light. The soil is the ordinary clay, mixed with a large quantity of limestone kunkur.

20. The Braminee river, like the others, is only formidable during the floods, when it fills a channel 300 feet wide with well-defined banks.

It rarely overflows its banks at the point of crossing. Here the Railway will be 13 feet above the river banks, and a bridge of about 400 feet in length will be required. This river, like those already described, has a sandy bed, with banks of clay and sand. In this neighbourhood red-iron ore is found in large quantities, also gooting in abundance on the line of Railway.

21. After crossing the Braminee, the country rises for about 3 miles, and an easy gradient of 1 in 2,000 can be obtained, descending again for 6 miles at a gradient of 1 in 1,000 to the Pugla Nullah, which is about 50 feet wide. The bed and sides of this nullah are of clay. The soil between the Braminee and Pugla Nullah, is the common alluvium.

22. From the Pugla to the river Banslee, the distance is 7 miles. The Railway will be on a level, on a low embankment. The country here is inundated from 2 to 6 feet deep in the rainy season.

23. The Banslee, like the other rivers, is diminutive in the dry season, and becomes an important rapid stream during the rains, filling a channel 450 feet wide, and about 12 feet deep, with a sandy bed and banks of clay; a bridge will be required about 550 feet long, with several land arches at each end of it.

24. Leaving the Banslee, the line goes in a straight direction a little to the East of North, leaving Kalkapore on the left, the gradient is 1 in 2,000, descending and crossing Lalla Nuddy 40 feet wide, and a low piece of land 3 miles in length, which is said to be inundated 7 feet in depth during the rains, but as the bottom is good sound clay, and the old embanked Mahomedan road is still in existence at a short distance from the line, evincing the stability of earth-works here, there seems no reason to apprehend any difficult or expensive works at this place. The whole is dry, except during the periodical inundations. The embankment shown on the section is 22 feet in height, but may be much reduced.

25. The line still keeping a generally good direction, bends to the West of North, leaving Pakour on the left, and is on a level for 7 miles through undulating country, and crossing the Putterghatta Nuddy 50 feet broad.

26. This Nuddy has a rocky bed. The banks are partly composed of boulders of basalt bedded in clay. The land is here flooded three feet in depth during the rains.

27. The line now rises at the rate of 1 in 1,000 for 2 miles to the Dar Nuddy, a small stream 20 feet wide; continuing in the same direction for 6 miles to Kankjole, the land slightly undulates, and the Rail-

way is on a level, passing the Kankjole Nuddy 40 feet wide, the Bugdoggerra Nuddy 50 feet wide, and the Gomanee Nuddy 100 feet in breadth. In the inundation of the last-mentioned three rivers, the water has a spread of 5 miles at a depth of 3 to 6 feet, the last depth being that of a very great flood. The soil is the common alluvial clay. A considerable amount of flood arches will be required here.

28. Leaving the Kankjole on the right, the line goes due North for about 5 miles on a level, crossing the Kutchwa Nuddy, which is about 130 feet wide; the land here is inundated in the rains about 4 feet in depth. The embankments will be heavy at this place, but may be improved by altering the level into a gradient. The soil is a loamy sandy clay, well-cultivated and dry, except during the rainy season.

29. The country now rises gradually, and we soon enter upon a jungly rocky district, the line rising at the rate of 1 in 1,000 feet for 2 miles, and descending for  $2\frac{1}{2}$  miles with the same gradient, and proceeding on a level for  $1\frac{1}{2}$  mile to Oodwa Nullah on the Ganges, and by an alternative line 5 miles further to the coal wharf at Rajmehal, now frequented by the Steamers navigating the river Ganges.

30. The cuttings in this portion will be of a different character from any of the preceding. The soil is rocky, the hills composed of basalt in large detached masses, and boulders imbedded in a ferruginous sandy clay. The greatest depth of cutting is 27 feet and that only for a short distance. The embankments all the way up to Rajmehal will be of the ordinary alluvial clay.

31. At Oodwa Nullah there is deep water in the river close to the shore. The distance by the line from Howrah, as already mentioned, is 199 miles, and this appears to be a favorable point for a wharf and landing-place. The place where the river steamers stop to take in coals at present, is five miles further up the river, close to Rajmehal, and 204 miles from Howrah; which of these two would be preferable for communicating with the river, and for a station, may be left for future decision when the requirements of the traffic are investigated. It may be sufficient at present to state that there appears to be deep water close to the shore from Oodwa Nullah all the way up to Rajmehal.

32. Bearing in mind that the Railway is intended to be prosecuted by Mirzapore to the North-Western Provinces, a question occurs as to the possibility of carrying it in a more direct course to Colgong, which is a very favorable point for impinging on the great river, and its advantages for traffic are at least equal to those of Rajmehal.

It would be possible to carry a line up the valley of the Goomanee Nuddy, diverging about the 185th mile, and in a North-West direction through the hills at Colgong. This route has been traversed by Major Baker, who states that the gradients at one point would be unfavorable, but of this alternative line no longitudinal section has yet been taken.

33. Having thus gone through the engineering part of this proposed line to Rajmehal, it will perhaps be superfluous at this time to do more than allude to the question of the expected traffic, which has been so ably discussed by others at sundry times, and which is already known to you.

34. I shall, therefore, only repeat, that the chief importance of touching the river Ganges, at or in the neighbourhood of Rajmehal, is that the enormous traffic of this river, which has been aptly termed the great highway of India, may in great or less proportion be expected to take the direct and safe route by Railway of 200 miles to Calcutta, in place of the circuitous and dangerous one of about 528 miles by the Sunderbunds. The shorter navigation by the Nuddea rivers, and the river Hooghly, being, as is well known, almost closed for many months throughout the year.

35. This subject is very clearly stated in Colonel Forbes's Report on the formerly proposed Rajmehal Canal, who also gives his opinion on the important point of permanent deep water at Rajmehal, to the effect, that from historical detail of the changes which have taken place in the channel of the Ganges in the vicinity of Rajmehal, and however far the main body of the river may for a time have retired from these rocks, yet that there was no reason to apprehend the river close to the shore would ever be left impassable for vessels drawing 5 feet of water.—(*See R. Canal Report of 1841, p.p. 22—23.*)

36. This opinion has been confirmed by experience up to this time, for although the main body of the river does not wash the ruined walls of Rajmehal as in former times, yet deep water is found close to the shore immediately below the town, and so continues for 5 miles at the least.

37. In conclusion, I may add, that the line will traverse a well-cultivated and populous country, at present suffering great inconvenience for want of the means of internal communication, also that valuable minerals are found at various places at no great distance from the line. In the Beerbhoom hills are found coal and ironstone, and copper ore is reported. At Domrah, near the 135th mile, there are some small smelt-

ing furnaces worked by the Natives, who succeed in producing cast and wrought iron of good quality and with a fair profit.

38. I feel some difficulty in giving even an approximate estimate of the line of Railway here proposed, because the time has been too short to allow me to ascertain the details of quantities which alone can give the means of arriving at an accurate conclusion.

Judging however, by a comparison with the 120 miles now under contract and in course of construction between Howrah and Raneegunge, I feel some confidence in stating that an average of £12,000 a mile will suffice for the whole of the works, that is to say, that for the 240 miles between Howrah, Raneegunge, and Rajmehal, the sum of about three millions Sterling will be required for the construction of the works, and for providing the complement of working stock and stations. More than this sum will not, so far as I can judge, be required, but I would not recommend that the amount to be anticipated and provided should be less than that named above.

39. I trust I may be pardoned for attracting the attention of the Board to the untiring and zealous exertions of Mr. Evans, the Resident Engineer of the Burdwan District, who accomplished a longitudinal section of 124 miles of Railway in the very short time which could be devoted to it and in addition to his other duties.

40. In sending out Engineers and Surveyors from England in prosecution of this line and its prolongation Westwards, it would be very desirable that arrangements should be made for their arrival in Calcutta in the beginning of October, because some time is necessarily consumed before they can commence operations, and the cold season, including November, December, January and February, is the only time when levelling and surveying can be carried on by Europeans in this country with any degree of efficiency and satisfaction.

I have the honor to be, &c.,

(Signed) GEO. TURNBULL.







SELECTIONS  
FROM  
THE RECORDS  
OF THE  
**GOVERNMENT OF INDIA.**  
(HOME DEPARTMENT.)

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Published by Authority.

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Nº. X.

P a p e r s

ON THE  
COAL OF THE NERBUDDA VALLEY,  
TENASSERIM PROVINCES,  
AND  
THAYET-MYO.

~~~~~  
Calcutta:

THOS. JONES, "CALCUTTA GAZETTE" OFFICE.

1856.

No. 58.

FROM

THE UNDER-SECRETARY TO THE GOVT. OF BENGAL,

TO

THE UNDER-SECRETARY TO THE GOVT. OF INDIA,

In the Home Department.

Dated Fort William, 24th January 1854.

MARINE.

SIR,

I AM directed by the Most Noble the Governor of Bengal to transmit herewith, for the consideration and orders of the Governor General in Council, an Extract of a Despatch* from the Hon ble the Court of Directors, relative to proceedings connected with the Geological Survey referred to therein.

* Para. 29, No. 28 of 1853, in the Marine Department, dated 9th November.

I have the honor to be, &c.,

(Signed) W. GORDON YOUNG,

Under-Secy. to the Govt. of Bengal.

Extract from a Despatch from the Hon'ble the Court of Directors in the Marine Department, (No. 28 of 1853,) dated 9th November.

Para. 29. WE observe that, at the suggestion of Professor Oldham, you have sanctioned his conducting the Geological Survey in future on a continuous and regular plan, instead of selecting for examination isolated and often widely separated tracts of country. From Sikree Gully, in the neighbourhood of Rajmahal, where he was employed at the date of your letter, he was to proceed regularly to the Westward, including in his survey all the country South of the Ganges as far as the published Revenue Survey map or maps of the Indian Atlas extend, that is to say, to some distance beyond the Sutlej. Such a syste-

31 to 36, Proceedings connected with the Geological Survey.

matic course is no doubt in most respects preferable to the other, and we see no objection to its adoption, unless it should appear likely to occasion a much longer postponement of the survey of the coal fields of the Nerbudda Valley, to which we can scarcely attach too much importance when we bear in mind the great expense and practical difficulty of supplying the Bombay Government with all their coal from Europe as at present. We infer, however, from a passage in Professor Oldham's letter, that a cursory examination, sufficient for practical purposes, might be made of any detached District, with respect to which geological information was immediately required without seriously interrupting the progress of the main survey. If this inference be correct, the Nerbudda District ought to be the earliest examined, and we wish this to engage your immediate attention.

(True Extract)

(Signed) W. G. YOUNG,
Under-Secy. to the Govt. of Bengal.

No. 160.

To

W. G. YOUNG, ESQUIRE,
Under-Secy. to the Govt. of Bengal.

HOME DEPARTMENT.

SIR,

I AM directed by the Most Noble the Governor General in Council to request that a copy of the Extract from the Hon'ble Court's Despatch, forwarded with your letter No. 58, dated the 24th ultimo, may be communicated to Professor Oldham, and that gentleman's opinion obtained as to the feasibility of an immediate cursory survey of the coal fields of the Nerbudda Valley, to which the Court attach so much importance.

I have the honor to be, &c.,

(Signed) G. COUPER,
Under-Secy. to the Govt. of India.

Council Chamber,
The 10th February 1854. }

No. 236.

FROM

THE SUPT. OF THE GEOLOGICAL SURVEY,

TO

W. GORDON YOUNG, ESQUIRE,

*Under-Secy. to the Govt. of Bengal.**Dated 2nd March 1854.*

SIR,

I HAVE the honor to acknowledge the receipt of your letter No. 119, dated 21st February 1854, enclosing, by order of the Most Noble the Governor of Bengal, copy of a letter from the Government of India in the Home Department, and of an Extract from a Despatch from the Hon'ble the Court of Directors, (No. 28 of 1853,) relating to the geological examination of the District of the Nerbudda.

In reply I have the honor to report for His Lordship's information, that the Hon'ble the Court have correctly interpreted my views, as conveyed in my letter No. 130, dated 2nd September 1852; and with reference more immediately to the valley of the Nerbudda, I conceive such a cursory examination of that District, not only feasible, but highly desirable. The Hon'ble the Court of Directors have indicated the great practical importance of that District, and I have already, on more occasions than one, stated my conviction, that in a purely geological point of view, the Districts of Central India will afford the best and clearest key to the true succession of the rocks in India.

But I must at the same time state, that such an examination of a District, lying at a very considerable distance from the country now under survey, must inevitably impede the general progress of our work, unless a corresponding increase to the staff of the survey should be sanctioned.

I do not consider the distance of the Nerbudda as any objection to its examination, excepting so far as results from the slowness and expense of moving about in this country. In some respects it offers a positive advantage. It is quite impossible for any geologist, however experienced, to gain a satisfactory knowledge of the structure of a new country, respecting which but little information had been previously acquired (and that little at distant points by isolated observers) without visiting a large—in some case, a *very large* area. Phenomena difficult of explanation, and unintelligible within a limited area, become at once clear, and instructive, when the clue has been obtained in some adjoining Dis-

trict. In this way I might remark that, although the first cold season which I spent in this country (1851-52) was without any result, so far as the examination or mapping of any new District was concerned, nevertheless, without the knowledge I then obtained by visiting the Damooda Valley and its coal fields, the country in which we have been since engaged would have been only half understood. Nor could any person, first placed in the Nerbudda Valley, fairly unravel its structure, without visiting the coal districts of Bengal.

I respectfully conceive therefore, that it would be much more advantageous to extend the present establishment of the Geological Survey than to form any new staff for the investigation of other Districts. In fact every such party, if isolated, would, of necessity, be working from its own horizon or datum; and it would require nearly as much labour afterwards to render their various results truly comparable as to have made them so in the first instance. The advantages of individual superintendence for very extensive Districts have been long acknowledged in Europe, where, from the facilities of comparison, it is even less required than in India.

I would further state, that should such an examination of the Nerbudda Valley be decided upon, the present would seem a favorable time for its prosecution. * As far as any published accounts enable me to judge, the District in which we should, in the regular progress of the survey, be engaged during the next cold season (1854-55) will not prove a very complicated one, so that my personal examination of it would be less essential.

Should the suggestion for an increase to the staff of the Geological Survey, corresponding to the increase in the area over which its labours would extend, be entertained, I should be quite prepared, with His Lordship's permission, to submit in detail my views and an estimate of the cost of such increase.

I would further venture to suggest, that the local authorities might be requested to furnish a summary statement of the localities in which coal, iron, or other minerals are known to occur, in the vicinity of the Nerbudda, with any useful information that the records of their offices may afford.

I have, &c.,

(Signed) THOMAS OLDHAM,

Supdt. of Geological Survey of India.

Camp Ungargurria, near Soory, }

The 2nd March 1854. }

No. 153.

COPY of the above letter forwarded to the Home Department, with reference to their letter No. 160, of the 10th February 1854.

By order of the Most Noble the Governor of Bengal,

(Signed) W. GORDON YOUNG,

Under-Secy. to the Govt. of Bengal.

*Fort William, }
The 8th March 1854. }*

No. 346.

To

THE UNDER-SECRETARY TO THE GOVT. OF BENGAL.

HOME DEPARTMENT.

SIR,

WITH reference to the Report of the Superintendent of Geological Survey of India, dated the 2nd instant, forwarded by you by endorsement, dated the 8th idem, I am directed to inform you, that the Commissioner in Saugor and the Resident at Indore will be called upon to furnish any information that they may possess, or the records of their offices may contain, in respect to the localities in which coal, iron, or other minerals are known to occur in the vicinity of the Nerbudda. In the meanwhile you are requested, under the orders of the Government of Bengal, to instruct the Superintendent to submit, for the approval of the Supreme Government, a list of the extra establishment which he considers will be necessary to enable him to prosecute a cursory survey of the coal fields, &c., of the Nerbudda Valley.

I have the honor to be, &c.,

(Signed) G. COUPER,

Under-Secy. to the Govt. of India.

*Council Chamber, }
The 24th March 1854. }*

No. 332.

To

THE SECRETARY TO THE GOVERNMENT

OF THE NORTH-WESTERN PROVINCES.

HOME DEPARTMENT.

SIR,

I AM directed to forward, for submission to the Hon'ble the Lieutenant-Governor, the accompanying Extract, para. 29, from a Des-

patch from the Hon'ble the Court of Directors in the Marine Department, No. 28 of 1853, dated the 9th November, together with copy of a letter from the Superintendent of Geological Survey of India, dated the 2nd instant, relative to the prosecution by him of a cursory survey of the coal fields of the Nerbudda Valley.

2. To enable Professor Oldham to enter upon this duty immediately, I am directed to request that His Honor the Lieutenant-Governor will be pleased to require the Commissioner of Saugor to furnish, for communication to the Superintendent, any information that he may possess, or the records of his office may contain, in respect to the localities in which coal, iron, or other minerals are known to occur in the vicinity of the Nerbudda.

I have the honor to be, &c.,

(Signed) C. ALLEN,

Offg. Secy. to the Govt. of India.

Fort William, }
The 24th March 1854. }

No. 311.

FORT WILLIAM,

HOME DEPARTMENT,

The 24th March 1854.

READ again Extract, para. 29, from a Despatch, from the Hon'ble the Court of Directors, in the Marine Department, No. 28 of 1853, dated the 9th November, relative to the prosecution by Professor Oldham, Superintendent of Geological Survey of India, of a cursory survey of the coal fields of the Nerbudda Valley.

Read a letter from Professor Oldham on the subject, dated the 2nd instant.

Ordered that copies of the foregoing papers be sent to the Foreign Department, with the request that the Resident of Indore may be required to furnish, for communication to the Superintendent, any information that he may possess, or the records of his office may contain, in respect to the localities in which coal, iron, or other minerals are known to occur in the vicinity of the Nerbudda.

No. 916 of 1854.

FROM

WILLIAM MUIR, ESQUIRE,

Secy. to the Govt. of the North-Western Provinces,

TO

CHARLES ALLEN, ESQUIRE,

*Secy. to the Govt. of India, Home Department,
Fort William.*

Dated the 20th April 1854.

GENERAL DEPARTMENT.

SIR,

WITH reference to your letter No. 332, dated 24th ultimo, I am directed by the Hon'ble the Lieutenant-Governor to intimate, for the information of the Most Noble the Governor General in Council, that instructions have this day been issued to the Commissioner, Saugor and Nerbudda Territories, to place himself in direct communication with Professor Oldham, Superintendent of Geological Survey of India, and to furnish him with the information required, regarding the geological features of the valley of the Nerbudda.

I have the honor to be, &c.,

(Signed) W. MUIR,

Secy. to the Govt. of the North-Western Provinces.

The 20th April 1854.

No. 288.

FROM

THE SUPT. OF THE GEOLOGICAL SURVEY,

TO

CHARLES ALLEN, ESQUIRE,

Secy. to the Govt. of India, Home Department.

Dated the 11th October 1854.

SIR,

THE great and growing demand for coal, and the fair prospects of obtaining a considerable supply from the Tenasserim Provinces,

have rendered it advisable, that I should, with a portion of my geological party, proceed to that District during the coming cold season. I am, however, very anxious to obtain as much sound information as possible, regarding the Nerbudda Valley, during the same time; but the smallness of my party at present, owing to the recent appointment of Mr. Henry Medlicott as Professor of Geology at the Roorkee College, prevents my being able to detach more than *one* Assistant to that District. I am therefore very desirous, as a temporary arrangement, to obtain the aid of Mr. Medlicott during this season. I am informed by him, that the period of the year set apart for lectures is during the rains, and that his absence from Roorkee during the working season would not interfere with his regular course of instructions. At the same time I am disposed to think, that the valley of the Nerbudda offers a better prospect of immediate returns of value than any of the Districts more immediately in his neighbourhood, on which he might be engaged.

I would, therefore, solicit the sanction of the Most Noble the Governor General to an application being made to the local authorities, North-Western Provinces, for the services of Mr. Henry Medlicott, during four months of the coming season (December to March or January to April as convenient,) with a view to his undertaking the examination of the Nerbudda District, in connexion with one of my Assistants.

In the event of this being sanctioned, I would recommend that Mr. Medlicott should be authorized to receive an allowance of Rupees 400 per month, said sum to include all usual allowances for travelling charges, horse, &c.; his regular pay as Professor at the Thomason College of course being continued during his absence* on this duty.

Before the ensuing cold season I trust the establishment of the Geological Survey will be so complete, that such temporary arrangements will be unnecessary.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,

Supdt. of Geological Survey.

Monghyr, }
The 11th October 1854. }

No. 1132.

To

T. OLDHAM, ESQUIRE,

Supdt. of the Geological Survey in India.

HOME DEPARTMENT.

SIR,

IN reply to your letter No. 288, dated the 11th instant, I am directed to inform you, that the Government of the North-Western Provinces has been requested to place the services of Mr. H. Medlicott at the disposal of the Government of India, with the view to his being employed in the examination of the Nerbudda Valley.

2. The Government of the North-Western Provinces has been further requested, in the event of Mr. Medlicott's services being made available, to direct him to place himself at once in communication with you.

3. Should Mr. Medlicott be employed on the proposed duty, the Most Noble the Governor General in Council will be prepared to sanction the grant to him of the extra allowance recommended by you, *viz.*, Rupees 400 per mensem, to cover all expenses of travelling, &c.

I have the honor to be, &c.,

(Signed) C. ALLEN,

Offg. Secy. to the Govt. of India.

Fort William,
The 20th October 1854. }

No. 1131.

To

THE SECRETARY TO THE GOVERNMENT

OF THE NORTH-WESTERN PROVINCES.

HOME DEPARTMENT.

SIR,

I AM directed to forward, for submission to the Hon'ble the Lieutenant-Governor, the accompanying copy of a letter from the Superintendent of the Geological Survey in India, No. 288, of the 11th instant, and to request that His Honor will have the goodness to place the services of Mr. H. B. Medlicott at the disposal of the Government of India temporarily for a period of four months, with the view of his undertaking the examination of the Nerbudda Valley.

2. In the event of Mr. Medlicott's services being made available, you will be good enough to direct him to place himself at once in communication with Professor Oldham.

I have, &c.,

(Signed) C. ALLEN,
Offg. Secy. to the Govt. of India.

Fort William,
The 20th October 1854. }

No. 1392 A. OF 1854.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to the Govt. of the North-Western Provinces,

TO

CHARLES ALLEN, ESQUIRE,
Offg. Secy. to the Govt. of India, Home Department,
Fort William.

Dated Camp Mynpoory, the 16th November 1854.

GENERAL DEPARTMENT.

SIR,

I AM directed by the Hon'ble the Lieutenant-Governor to acknowledge the receipt of your letter, No. 1131, dated the 20th ultimo, with its enclosure, and in reply to state, for the information of the Most Noble the Governor General of India in Council, that as therein requested, His Honor has this day placed the services of Mr. H. B. Medlicott at the disposal of the Government of India temporarily, with the view of prosecuting an examination of the Nerbudda Valley.

I have the honor to be, &c.,

(Signed) W. MUIR,
Secy. to the Govt. of the North-Western Provinces.

Camp Mynpoory,
The 16th November 1854. }

No. 1211.

COPY forwarded to the Superintendent, Geological Survey, in continuation of the letter from this Department, No. 1132, dated the 20th ultimo.

By order, &c.,

(Signed) W. G. YOUNG,
Under-Secy. to the Govt. of India.

Home Department, }
The 23rd November 1854. }

No. 30 A.

FROM

THE SUPT. OF THE GEOLOGICAL SURVEY,

To

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India.

Dated the 19th July 1855.

SIR,

I HAVE the honor to forward herewith, for the information of the Hon'ble the President in Council, and for communication, if desirable, to the Governments of Bombay and of the North-Western Provinces, a brief summary of the results of the examination of the Nerbudda Valley during the past season, so far as regards the commercial value of the coal and iron deposits known to occur in that District.

As I stated at the time when the examination of the Nerbudda Valley was ordered by the Most Noble the Governor General in Council, that one season would not suffice for the full investigation of so extended an area, my instructions to Mr. Medlicott, on proceeding there, were that his primary and special attention should be given to such points as afforded any prospect of future commercial importance, reserving a more detailed search in elucidation of geological questions and for the discovery or further tracing out of these deposits for a future time, as it was desirable that some definite information should be laid before the Government at as early a period as possible; and the President in Council will perceive that these instructions have been fully carried out.

I would also add, that having been misled by the information I received in reply to my enquiries on the subject, as to the period of the year at which it would be safe to enter the Nerbudda Valley, I delayed Mr. Medlicott at other work in Bengal, so that he only reached the Nerbudda District in January, although he then found that the resident authorities usually proceeded into their Districts some two months earlier. This un-

fortunately reduced the working season in that part of the country very considerably, but such an error will of course be avoided in the coming year.

The discussion of more purely geological questions, requiring for their illustration plans and sketches, which always involve time in their preparation, is reserved for a future occasion.

I would further state, that I look upon this Report as very highly creditable to Mr. Medlicott, under whose charge the small party working in that District were placed. The facts he mentions, and the inferences he draws, for the most part, are confirmatory of the statements of previous observers; and in all cases where his conclusions differ from those previously arrived at, his reasons appear to me satisfactory. To instance one point, I believe he has, for the first time, explained the true cause of the superiority of the Tendukhera iron, by showing that the ore is naturally and unavoidably combined with its proper flux. In other points he has stated his conclusions fully, and they do not call for any further remark.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,

Supdt. of Geological Survey.

Prome,
The 19th July 1855. }

The original Report was in the form of a letter to myself and I have not altered it.

To

THOMAS OLDHAM, ESQUIRE,

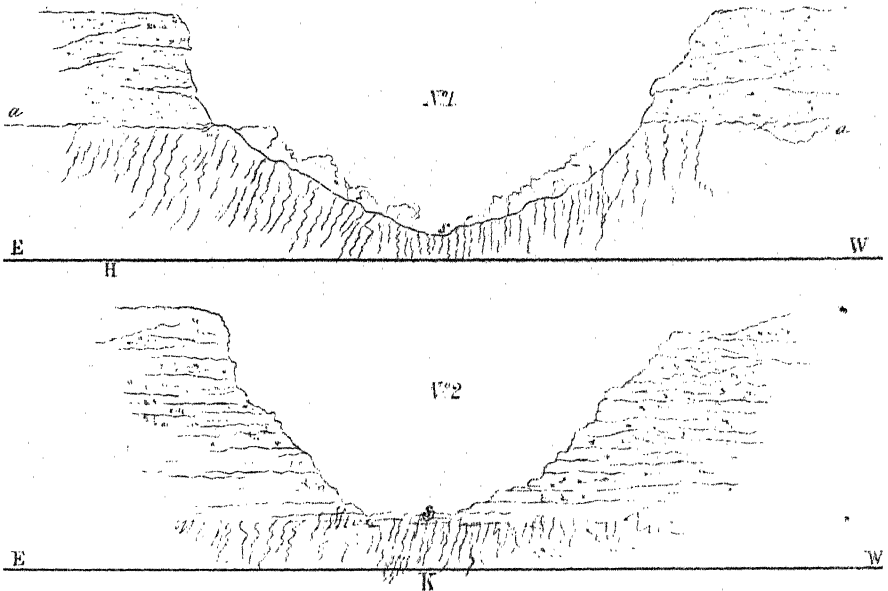
Superintendent of Geological Survey.

THE coal-bearing rocks of the Nerbudda Valley, as you are already aware, extend along its South side; the escarpment of the hills in that direction being for the most part composed of the beds of the coal-bearing conglomerate and sand-stone. This is the case at least from Gaugra, South of Nursingpore, to near Seeoni, in the Hoosingabad District, including a distance of about 120 miles in a straight line, between which places I examined that part of the Goandwarra range which lies along the Nerbudda Valley, namely, its escarpment to the North, on and near which all the known out-crops of coal are. I was prevented from penetrating far into the interior of these hills, by the necessity of visiting all these known localities and the short time left to accomplish that undertaking, which rendered it impossible to attempt a journey into a

country covered with dense jungle, almost totally without cultivation, where there are few villages, no roads, and scarcely even a path along which a poney or loaded ox can travel.

The information then which I have to place before you is confined to that part of the area covered by coal-bearing rocks which are known to extend far to the East and South. Within the area which I have visited, however, occur all, or nearly all, those localities where coal has been found by previous explorers, and principally to these localities I shall call your attention. Taking them as they are met with in proceeding from East to West, the first is that situated on the Hurd Nuddee, near its junction with the Sakur.

The following Sketch Sections will help me to convey more intelligibly what I have to say about this part of the field :—



No. 1 is taken across the entrance to the gorge, out of which the Sakur Nuddee flows. The course of the stream is Hurd Nullah. represented at S. H. is the position of the village of Hutnapur; projected on the section it really stands in the plain; and North of the line of section altogether, at (*a*), the beds of coal-bearing conglomerate rest on the lime-stone of the schist formation, which I have represented as dipping at high angles and contorted, though here it is hardly to be seen at all. Occupying as it does the lower third of the height of the hill, it is covered by the talus of broken fragments from the upper beds. The conglomerate is composed, in its lower beds, of pebbles of the schist rocks, the maximum size of which seems to be 5 inches diameter, but the average much smaller. The higher beds are composed exclusively, or nearly altogether, of small rounded pebbles of quartz and jasper. There is no sand-stone seen here.

No. 2 is taken parallel to No. 1 and crosses the gorge in an East and West direction, about a mile and a half further up the stream or South; S being the Sakur stream and K the position of the village of Konda.

No. 3 is supposed to run at right angles to the other two. Taking the Sakur Nuddee for its base, and showing the general features as you look to the East, H represents the position of the village of Hutnapur, S and K as before, and (*a*) the same as in No. 1.

As you ascend the gorge the lime-stone is lost under the coal-bearing sand-stone, and I have represented, in Nos. 2 and 3, how the vast number of immense blocks of conglomerate, which have fallen from the beds high on the hill-side, renders it very difficult to make out satisfactorily the real position of the rock beneath, although they give to the gorge an exceedingly picturesque appearance: thus it is obscure what the rock is which actually rests upon the lime-stone, near the village of Konda (K in sections.) I have represented in Sections 2 and 3 beds of sand-stone lying on the lime-stone near Konda, which have replaced the conglomerates seen in the hill-side at (*a*), and in my section have taken for granted that the said conglomerate beds do not continue under them. This would imply the probability, that there is now exposed along the escarpment, at the North of this range, what was the original shore of the coal-bearing basin; that the conglomerates there seen were being formed at the edge of that basin, while sand-stones, shales, &c., were being deposited in the deeper water to the South; the result of which deposits we now see in the sand-stones and shales exposed at Konda and

thence along to the junction of the Hurd and Sakur. Although this I believe to be the true state of the case, yet, from the obscurity before mentioned, and the difficulty of seeing clearly if the sand-stone beds near Konda really rest on the lime-stone or not, there remains the possibility of a fault, which, running East and West, may have had a sufficient downthrow to the South, to have let down all the conglomerates seen at (*a*), which would thus underlie what we see from Konda up the Sakur, and also the lowest sand-stones exposed in the Hurd section.

There is every kind of presumptive evidence against this supposition, and I reject it the more readily as I have never seen any rocks in which the characteristics developed in any one spot are so little persistent in horizontal range as here; and after an acquaintance with the formation, extended over 200 miles at least of its range, and not altogether slight, I find little difficulty in believing that the great beds of conglomerate at (*a*) are represented at not more than a mile off, by a few pebble runs of coarse sand-stone and pebble beds. Thus I arrive at the conclusion, that the sand-stone seen in the stream near Konda, Sections 2 and 3, is really the bottom rock of the formation there; and so, if this supposition be good, the bottom rock seen in the Hurd Nuddee may be also taken as equivalent to the same; and the section there exposed, a fair representation of the lowest member of these coal-bearing rocks in this part of the field.

The thickness of these lowest beds cannot be seen in the Hurd Nuddee. There are several of them well exposed; the stream cuts through and hollows out the immense blocks of which these beds seem composed; they are 20 to 30 feet thick; the rock a pale grey and brown sand-stone, rather fine-grained, loosely-aggregated, and very uniform in texture, with remarkably little mica. Along the partings and in the cracks and joints a ferruginous red argillaceous grit is often formed, which is very hard, concretionary in some places, and often rich in iron. This may be taken as the characteristic rock of the coal-bearing formation, and it at least varies very little from the type wherever I have seen it.

Here, among the lowest beds, there are seen layers of white grit, with alternate lamina of carbonaceous matter, and higher up in the section many concretions of red iron-stone occur. These accumulations, which characterize the upper portion of these lowest rocks, are striking from their size and the way in which the weathering of the rock exposes them. Some, affecting an oval shape, measure 20 feet on the longer by 10 feet

on the shorter diameter, and are six to ten inches thick in the centre ; others are very irregular in outline and thickness, and most seem to be rich ores of iron. The dip of these lowest beds varies considerably in degree and direction— 20° to S. E. may be taken as the average. Above these comes

Shale No. 1—dark blue, earthy, inconstant in thickness, with carbonaceous partings and some faint vegetable impressions. No coal. Ascending sand-stone, single bed, five feet thick, including a layer of grit more compact than the typical sand-stone described. It forms the floor of

Shale No. 2—ten feet thick, greyish blue and micaceous ; includes at about one-third from the top a parting of ferruginous grit 3 to 4 inches thick. Throughout these are layers, some more micaceous, some more carbonaceous, recurring and alternating at intervals, the latter often sufficiently strong to give a dark colour to many portions of the mass. They abound in vegetable impressions, seldom however well preserved. Above the grit parting above-mentioned, and near the top of this shale No. 2, there are two small irregular bands of coal 2 to 3 inches thick in some parts of their horizontal range. These little bands are free from those admixtures of clay and mica which generally characterize them, but more frequently the impurities so predominate as to leave a micaceous shale scarcely darkened by some patches of carbonaceous matter, and thus they die out and come in again. This shale is here cut off by a fault which runs S. 55 E. and is a downthrow to the South. On the North of the fault, shale No. 2 disappears under a sand-stone 2 feet thick, on which rests

Shale No. 3—which is precisely like shale No. 2 ; it contains a band of rich red hæmatite, in some places 4 inches thick, but very variable. Above comes in sand-stone, typical coal-bearing rock. Then

Shale No. 4—seven feet of blue and grey argillaceous and carbonaceous shale, with micaceous bands, and also containing leaf impressions, but no coal. Sand-stones 10 feet. Typical coal-bearing sand-stone perhaps slightly more micaceous than in its normal character.

Shale No. 5—1st, at bottom there is a little band of coal 10 to 14 inches thick, but very unpromising in aspect. Along 100 yards of its out-crop, which is here exposed, the quantity of carbonaceous matter is very variable, indeed much of the bed would not support combustion ; and where best in quality, the true coal seems to collect into a thin layer in the centre of the little band, leaving the latter destitute of carbonaceous matter above and below.

2nd.—A sand-stone bed 2 feet thick, with many bands of carbonized vegetable impressions and frequent nodules of pyrites.

3rd.—A dark-colored shale 2 to 3 feet thick.

4th.—Sand-stone 2 to 4 feet thick, hard, red, and full of nodules of pyrites.

5th.—Dark-colored shale 1 foot 6 inches, containing many carbonized vegetable impressions. Here I found distinct zamia-like leaves, some reed or grass stems, and two fern leaves, which occur in the higher beds of shale in the Rajmahal Hills.

Shale No. 5, with its out-divisions, is covered by massive beds of sand-stone, in which I did not succeed in detecting any of those landmarks which would warrant the continuation of a measured section.

You will remark that I have not attempted any great precision in my statements of measurements, which I have given in the above section. The *habit* of the rock renders it quite useless so to do, and were I to copy the measurement of each bed, as made on the ground, I should run the risk of misrepresenting the general character of the Section instead of conveying a true idea of it. All the beds seem to partake even more than is usual in a sand-stone formation of the "lenticular" manner of arrangement; seldom persists in any one characteristic along the horizontal range; and where a bed of shale does look as if it maintained its general appearance, thickness, &c., a closer examination will show that the elements of which it is composed *do* vary notwithstanding, and it will be found to become more or less carbonaceous, &c.

Although I followed the course of the Sakur for several miles into the hills along its banks, I found only the thick rolling beds of the coal-bearing sand-stone exposed, all of which is over the Hurd section, unless a fault, which I have failed to detect, cuts off the continuity; but a very great thickness is not necessarily implied, and save the beds seen in positive succession one over the other in the hill-side, little secure data for estimating thickness by the dip can be attained, without a very careful examination of the rocks up the many almost inaccessible ravines which intersect them.

Captain Ouseley mentions this place, stating the coal to be 3 feet thick. I believe, nevertheless, that I have not under-stated the value of *what is seen*, and that it is worthless commercially, and offers no reasonable prospect whatever of repaying the labour of digging down on the chance of improvement. Some iron might no doubt be got out, but I

think with profit only if taken along with something else on the spot : alone it never could pay. The expense of a road from here to the plain of the Nerbudda Valley would be very considerable—in short it never could be profitably worked ; but I think the section may prove interesting when the country to the South comes to be examined, as it will serve for a starting point from the base of the formation and help to throw light on the structure of the central portion of the basin.

The next locality to which I have to conduct you is Mopani or Benar,

at a short distance from each of which villages the
Mopani or Benar.

Sitarewah Nuddee exposes a section of the coal-bearing rocks, at a distance of little more than a mile from the place where that stream leaves the hills for the plain ground of the Nerbudda Valley. Traces of the rocks of the schist formation are seen exposed in its banks, but all such are covered up by the gravel, red clay, and black surface soil through which the stream has cut its way, as its course is ascended and long before the foot of the hill is reached. Still there is reason to think that the first rock come to rests at no great distance below upon those of the schist formation. Nearly opposite the village of Mopani the following section commences, with what is here the lowest rock of the formation.

A conglomerate of a fine, green, earthy base, which is slightly calcareous in places, and the pebbles of which are exclusively derived from old crystalline rocks—this passes up into a coarse soft sand-stone, which in places contains many pebbles, though not quite a conglomerate. A remarkable trap dyke cuts these rocks just here—it is 50 feet thick (wide.) Where it is shown in the stream, there are several off-shoots running parallel to the mass, and presenting with the portions of sand-stone and conglomerate caught up by them—many finely seen instances of the phenomena of alteration.

Passing upwards there are thick and thin bedded sand-stones dipping to the East, at angles varying from 5° to 20° ; these also contain bands of pebbles, and are alternated with some beds of greenish micaceous flagstones. These are succeeded above by an alternating series of shales and sand-stones ; the shales are dark-colored, hard, fine-grained, though arenaceous, and contain carbonized impressions of reeds. In one or two cases there is among these shales a trace of coal. One little bed, 6 inches thick, is found in the South bank of the stream, but does not appear on the other side. There are some bands of soft blue shales and some of soft grey micaceous sand-stones, interstratified with thin partings of coal.

On these rest a bed of coal dipping E. 35° S. at 25° , and measuring 5 feet, of which a foot at top and bottom seem impure, leaving about 3 feet in the centre of excellent coal.

Hard blue and grey shales of varying thickness.

Sand-stone.—A pale yellowish grey rock, worked here for flags; in places contains much mica; it is 30 feet thick and dips E. 25° S. at 25° .

Shale.—Grey and hard, 10 feet thick, dips E. 35° S.

Coal.—10 feet thick, looks *very promising*.

Sand-stones.—Grey, thick-bedded, including bands of red and blue shale 50 feet thick, dips E. 5° N. at 15° , and with these ends the section in this direction, as they are covered by a series of conglomerate beds, which I have not succeeded in tracing to any satisfactory connection. A small fault displaces the out-crop of the coal beds and exposes four places in the stream, which have been mistaken for evidence of the existence of 3 beds. There are really however only 2 in which, including the whole thickness of the lower one, where I measured it with the impurities there noticed, we have 15 feet of coal, in two beds well exposed in the banks of the stream and dipping at angles varying from about 20° to 25° .

From the lower bed were taken those specimens of coal sent to Bombay under the name of Benar coal, and which, in spite of the unfortunate result of the experiment, were so greatly praised by the dock-yard authorities there. At the out-crop it looks poor, but of good promise notwithstanding, for the bad qualities seem to be rather the result of deterioration from atmospheric causes than of original admixture of impurities during deposition.

In 1849, it was stated in a Report addressed to Lord Faulkland, by J. Lushington, Esquire, "that in consequence of the difficulties met with in "transporting coal from this place to Bombay, the fuel was so smashed up "and mixed with foreign substances before it reached the dock-yard, as to "be quite unfit for use until carefully cleaned."

It has been found to coke well; it seems remarkably free from sulphur. Although at the out-crop it crumbles readily, yet, at a slight depth below, there is reason to think, that it may prove capable of packing well, nor do I believe any coal could have been with impunity submitted to the trial, which the Benar coal had to undergo in its journey to Bombay.

The dip is rather high, and there is some reason to anticipate that water may prove troublesome in the working. This may probably be at

first, at least guarded against by working from the out-crop to the East, along the strike horizontally, as the ground rises in that direction, the beds being seen just under a spur of the general range, which stretches a little to the North just here. As some set off, too, against inconveniences likely to arise from drainage, the stream offers a water power, which may I think be made available. The spot is easily accessible from the great valley, above which it is a little raised. The difficulties of constructing a road are slight, and although as long as the difficulties alluded to by Mr. Lushington, existing in the absence of all means of transport, are still extant, it may be impossible to make the coal from here pay its expenses in a market so distant as Bombay; yet, if any demand were to be created in the Nerbudda Valley, or any means of carrying the fuel to greater distances found, mining operations could, without doubt, be profitably carried on. In the event then of a railway, which would furnish both a demand and a means of transport, this place must prove a valuable source of coal.

In the bank of the Tawa Nuddee, where it leaves the hills, there is exposed, under the old fort of Bagra, a section, showing a fault which here brings the coal-bearing conglomerates into contact with the lime-stone of the schist formation. This conglomerate seems to be the same which at Mopani lies at the bottom of the coal-bearing series there, and here the fault seems to be of small amount and probably very local. Above come beds of the typical coal-bearing sand-stone; the dip is irregular and rolling; the beds thin out, and there are some bands of shale; but *no coal appears in a position relative to the bottom conglomerate corresponding with that in which the Mopani beds are seen.*

On entering the area drained by this Tawa River farther to the West by the Patroda Pass, the sand-stones are seen to rest on the schist rocks, without the intervention of the conglomerate, as far at least as I explored that part of the boundary. There are three principal tributaries of the Tawa, the Suktara, the Bhora, and the Sukni, which drain the undulating table-land lying within the Northern escarpment of the Goandwarra hills. In this part of the District they flow towards the East on their way to join that stream, and expose many sections of the coal-bearing rocks. These, when taken together, show that the sand-stone has a variable and rolling dip, and is cut through by trap in many places, which often overflows considerable areas. This trap does not violently

disturb the sand-stone, and seems to alter it only where in absolute contact therewith, never extending its influence many inches. The succession of the beds is so often broken by the trap, and the direction and amount of the dip so various, that it is impossible to estimate the thickness of sand-stone exposed in these sections—perhaps even the closest examination may fail to give certain results.

The Bhora Nuddee, at Sonada, shows the out-crop of two little beds of coal, which, whatever may be the aggregate thickness of the sand-stones of the District, lie at or near the bottom of it. These, Mr. Johnson states, to be 6 and 7 inches thick respectively, but he excavated all that could easily be taken away from the out-crop, and the stream has since then filled up the hollows made, and thus very little can now be seen of these beds. He found 18 inches of coal in a pit which he sunk on the East bank of the stream, which gave fuel of good quality, but his pit is filled with water far above the level of the coal, so that I failed to see it either. However, the cost of transporting this coal on the backs of oxen for more than 100 miles, before it reaches the water carriage of the Nerbudda, seems to have put a stop to Mr. Johnson's attempt. The first 30 miles are over an exceedingly bad road. Possibly, if a demand existed at Lokurtullie, Sewni or Herinkaire, a road might be made, and the mines made to pay, though most probably, if any working existed at Mopani, the superior advantages of that place would be sufficiently great to render any attempt here unprofitable.

It may also I think reasonably be doubted if boring throughout the valley will ever bring to light any more promising locality than that opened by Mr. Johnson at Sonada. From what I have above stated of the area occupied by the coal-bearing rocks in this neighbourhood, it will be seen that, did such better bed of coal exist, it might naturally be expected to appear at the surface. Under the circumstances I have described the disturbances caused by trap, the changing nature of the dip of the sand-stone, and the many sections exposed by streams, which, running in all directions, drain the table-land and valleys of the coal-bearing rocks, still the District has been examined by Colonel Ouseley, Mr. Conebeare, Mr. Johnson, and by me, besides many geologists, who have left only traditional records of their researches, and yet no out-crop of coal has been found so good as at Sonada. All this is of course not conclusive, but will I hope satisfy you that the prospects here are not very brilliant, nor do I think much encouragement is suggested by the general aspect of the rocks.

In order to place before you some means of judging of this, I shall now give you a somewhat detailed account of the section seen near the junction of the Sukni Nuddee with the Tawa. In the former stream the place is mentioned by Mr. Johnson as suggestive of the hope that trials throughout the field may be successful in hitting on coal; but as I say I think an examination of it is calculated to produce the contrary impression, it is characteristic of the District.

From the Tawa Nuddee up the course of the Sukni towards the South and East—

	<i>Descending Feet.</i>
No. 1.—A coarse, soft, greenish, earthy and slightly micaceous variety of the coal-bearing sand-stones, containing little nests of coal, dip. N. 10 W.,	—
No. 2.—Coal-bearing sand-stone, with threads of carbonaceous matter, includes a lenticular mass of thin bedded green micaceous sand-stone, which thins out and disappears, dip. N. 15° E. to N. 15 W.,	20
No. 3.—A set of thin-bedded sand-stones, green, earthy, and micaceous, along some of the partings carbonaceous and on others ferruginous markings. These thin out towards the East, where No. 2 is seen to rest on No. 4, dip. N. 30 W.,	8
No. 4.—Coal-bearing sand-stone, with threads of coal and little veins of carbonate of lime—in parts the mass will effervesce with acid,	—
No. 5.—A set of irregular beds of shale and earthy sand-stone; here occur the larger nests of coal. One, the best I saw, measured 2½ inches in the thickest part, from which it rapidly thinned out, and was lost among the false bedding of the sand-stone within 4 feet horizontal. There is also a bed 6 to 8 inches thick of dark-colored shale, one or two of the laminae of which might perhaps be called coal, but these never exceed 2 inches in aggregate thickness and are soon lost in the shale,	—
No. 6.—Thick bedded coal-bearing sand-stone, with many threads of coal and patches of shale,	—
No. 7.—Coal-bearing sand-stone, with veins of carbonate of lime, dip. N. 15 E.,	—
No. 8.—Earthy thin-bedded sand-stone, micaceous, soft and decomposing in the low bank of the stream; these contain the two best bands of coal, seen 3 and 2½ inches thick respectively, and apparently continuous; there are also a few beds of dark-colored shale,	10 or 12
No. 9.—Coal-bearing sand-stone,	10

- | | |
|---|-----------------------------|
| | <i>Descending
Feet.</i> |
| No. 10.—Blue and green sandy shales and earthy micaceous sand-stones, thin-bedded traces of coal, dip. N. 10 W.,..... | — |
| No. 11.—Coal-bearing sand-stone, with threads of dark grey micaceous shale, and some veins of carbonate of lime, | — |
| No. 12.—A series of thin-bedded sand-stones and common coal-bearing sand-stones, which pass down into a green mud-stone; itself seem to rest on the granite near Loharpur village, situated several miles to the West and South up the valley of the Sukni and near the foot of Bowergurh hill, | — |

With regard to the thickness of the different parts of this section, though I measured all carefully and endeavored to estimate irregularities fairly, yet I cannot venture to set down figures, which could only mislead; but I have already drawn your attention to this subject on the occasion of a former measured section which I have given. Balancing then the causes of error as well as I can, I believe that the aggregate thickness seen in this place may be stated as a little under 200 feet, exclusive of the green mud-stone, which, showing scarcely any traces of bedding and being cut by the trap in several directions, it is quite impossible to estimate. It forms the underlying rock of the formation at (this) the only place where the boundary of its South limit was reached by me. A closer examination of the country may no doubt give data for estimating thickness and other points, which I call impossible; but you will remember, that your instructions did not encourage me to spend time in trying to throw light on the structure of the country, where it was not more immediately connected with questions commercially important. With reference to the threads of coal mentioned by me in the above section, they seem to be caused by very thin accumulations of carbonaceous matter formed between some two layers of the false bedding of the sand-stone, and which, from the soft texture and irregular wearing of the surface of that rock, trace their little out-crops over it in waved threads. I need scarcely add that the *coal* here is perfectly useless.

As far as my present acquaintance with the structure of this coal field gives me any ground for an opinion, I believe that there is some reason to think that these traces of coal, shale, &c., as well as the sand-stone beds, have nearly the same relative position in the formation as the Mopani coal, and may so far be said to represent it; and thus, although in this part of the District the hope may be slight of finding any good beds of coal, yet the country to the East may reward our future exami-

nation, with the detection of a more valuable representative of the coal-bearing part of the formation—meantime there is at Mopani a locality well worth the notice of any one who wants coal, and the exploration of which would repay the labour expended, if only a market be found within some reasonable distance of the place, or some means of transport, which would overcome the obstacles which now exist in the absence of roads and the impracticable navigation of the Nerbudda.

IRON.

The geological association of the iron ore deposits of the Nerbudda Valley, looked at generally, seems to connect it with the line of disturbance which has determined the escarpment of the hills along the North side of that valley. These deposits seem to rest on a bed of highly altered sand-stone (quartzite) or on a peculiar quartz-breccia, which is seen in many parts of the same line, and to lie under the lime-stone of the schist formation. This is a fair statement, as far as the often nearly vertical position and general disturbance, to which the rocks have been subjected, permit such relations to be positively and definitely stated. Moreover, the trap comes out among and covers the older rocks so frequently along the above-mentioned line, that nothing is really added to the “history of the conditions,” by stating that that rock seems always to appear near where the iron is seen. The line alluded to almost always lies on the North side of the river: on it stand Panagurh, Tendookhera, Bamber, besides many other localities where workings exist, and many more from which ore has never been extracted. There are it is true places in the valley where the ferruginous lands of the coal-bearing rocks have been, and are, used as a source of iron, such as the neighbourhood of Gungye (South of Nursingpore,) but this and other similar places are insignificant when compared with those situated as above described. In some places these ferruginous bands of the coal-bearing rocks contain a rich ore, though they are seldom thick, and still more seldom look as if you could count on their maintaining the character which they have at any one spot, far in the direction of their horizontal extension; still when the coal beds at Mopani and elsewhere come to be worked, the extraction of iron-stone in connection with coal may perhaps be looked forward to as a source of profit. *The* iron deposit of the valley is however geologically confined to the line above pointed out, and as far as my examination of several points along that line

may justify the opinion, I believe that no doubt need be entertained of the abundance of the supply. At first I believed that the iron ore deposit was of an origin more recent than the rock with which it is associated. Though this is true of those masses of detritus and gravel used in many places for smelting, a more extended and closer examination of the sources, from which the gravel and detritus themselves are derived of the rock *in situ*, has led me to question the truth of my former belief, and to conclude that the weight of evidence so far is in favor of the syn-chronisism of origin. This is however of less importance than the fact of the actual abundance of the ore, which is indisputable, especially in the neighbourhood of Chandgurrh and Bamber. I shall now describe the different localities which I have visited.

The town of Tendookhera stands in the flat of the Nerbudda Valley,
 Tendookhera. about a mile from the Northern escarpment, and
 on the black soil which covers those fertile plains.

The mines are situated at about 2 miles to the South-west, nearly under a long low hill of lime-stone. I was surprised not to find the workings more extensive, although they are far more considerable than any I have since seen, and to find that the ore is extracted almost entirely from open quarries. After cutting through about 20 feet of the red and yellow clay which here underlies the black surface soil, the vein or bed is reached. From the very surface however indications of its presence may be traced, and through the clay a vast number of fragments are scattered, small in size above and gradually increasing with the depth. On the North side, that is below, for the dip is towards the South, the deposit seems to rest on a siliceous rock, fragments of which not only occur with those of the ore, scattered through the clay at that end of the workings, but the ore itself is apparently associated with a siliceous matrix; whereas towards the South it is evidently calcareous, and still farther in that direction the lime-stone is largely developed. In the pits indeed I did not see the siliceous rock *in situ*, whereas the lime-stone is prominent; and from the great amount of fracture and disturbance to which its beds have been subjected, it is not easy to determine whether the deposit of iron ore may not be positively interstratified with it, or whether the ore may not have been accumulated in the cavernous hollows in the lime-stone beds at their out-crops, or lastly, whether a single bed of the ore, originally lying between the quartzite sand-stone below and the lime-stone above, has not been faulted, so as to assume the ap-

pearance of interstratification with the upper rock. Looking on what I saw at the Tendookhera mines, by the light thrown on the question by an examination of other localities, I prefer the last of these explanations—I believe it fits the facts, though some evidence does appear in favour of either of the other suppositions. The mass of the ore is exceedingly hard and tough and difficult of extraction; the slight soft picks used render it a work of immense labour to detach fragments from the mass, and a very great waste of labour is incurred, by the way in which the produce is raised to the surface. Water readily collects in the pits, and no pains are apparently taken to avoid the falling in of great flat blocks of the lime-stone, which they leave unsupported, and which accordingly not only shut up some of the most productive burrows now and then, but have more than once caused loss of life. The ore, which is of a very mixed character, though almost every where rich, is principally earthy brown and red hæmatite; here and there masses of specular iron, apparently united in the same general aggregation, are seen: this variety is very heavy, after a fine steel grey, metallic looking ore, weathering red. The produce of the mines is carried in carts, but I am informed principally on the backs of oxen and buffaloes, to the town, where it is smelted; at present the scarcity of fuel is very severely felt, charcoal being brought from great distances; Mr. Jacob states 36 miles; I did not, at the place, hear more than 10 miles mentioned. It is however far more costly than at any other place where iron is worked in the District, and yet though precisely the same process is followed everywhere else, the iron from the Tendookhera furnaces undersells the Poonassa iron at Poonassa itself and to the West at Indore, Mundlaisur, &c. Lieut. R. H. Keating, in his Report to Sir R. Hamilton, dated March 1854, states that he considers this circumstance to be due to the bad way of working followed at Poonassa, but I think it cannot be so explained. Men have more than once been got over to Poonassa from Tendookhera, and I think no difference worth noticing can be seen in the manner of working in the two places. The secret I believe lies in the lime, which is involuntarily taken out of the pits at Tendookhera, along with the ore itself, frequently so strongly impregnated as to effervesce with acid, a peculiarity which I have never found in the ore taken from any other locality which I have visited.

Although the general geological position of the iron deposit at this place is the same as at Bamber and Chandgurrh diggings, whence the

ore for the Poonassa furnaces is obtained, yet, from the circumstances of the faulting and crushing of the beds of lime-stone, when the ore is here extracted, from infiltration taken in connection with these or from other causes which I have failed to trace, the mass of the ore at Tendookhera, especially towards the South side of the little area worked, is as stated impregnated with lime.

The diggings near Chandgurrh, which supply the Poonassa furnaces, are
 Chandgurrh and Poonassa. small burrowings spread over a considerable area.

They there work only a gravel composed of pebbles of rich heavy ore, and as this deposit is thin, they soon exhaust the supply obtainable from any one spot. I did not here see a pit more than 4 feet deep, nor could I find that the ore *in situ* was ever reached, though I believe it to be at no great distance off. This iron gravel does not by any means cover the face of the country, but seems confined to irregularly distributed patches, spread principally along the lower slope of the little range of hills which here represents the great escarpment. To the North and East from these diggings are many other localities, where ore is being, or has been, extracted, but by far the best of these is near the village of Bamber—at that place both the gravel deposits and the ore *in situ* are worked, the former principally, from the greater ease with which it can be removed. It occurs here precisely, as at other places in the neighbourhood, lying near the surface, in the slight depressions of the older rocks and filling the inequalities worked into them by denudation. It is frequently agglutinated into a very hard tough mass, by red ferruginous clay; the fragments are seldom much rounded, often perfectly angular, and in some places adhere to each other with very little of the clay cement.

The ore *in situ* worked here is very rich indeed; it is almost exclusively fine specular iron ore, with a clean metallic lustre on the fresh surface, and bright red streak. Unlike that at Tendookhera there is little mixture, and the bed or vein may be traced for miles, holding along the general strike of the lime-stone beds and the altered sand-stone. In several places where I crossed its out-crop, it seems at least as good as where they work it.

At Bamber, 2 miles from the mines, there are four furnaces; at Karia, 6 miles off, fifteen or twenty; at Baline, 3 to 5 miles off, six or eight; and I am informed about as many more smelting villages, in different directions, are all supplied from the diggings here. This is decidedly the most

prolific source of iron that I have seen in the valley, and seems to me to offer a supply of material practically unlimited. It is not possible with present information to make such an assertion of Tendookhera, for the out-crop of the iron bed there is hidden in both directions. Supposing it to continue, as here, along the strike of the lime-stone and quartzite sand-stone, a few trials would of course answer that question whenever it becomes desirable to do so.

In conclusion I have a few remarks to make on Mr. Jacob's Report, into the statements contained in which you instructed me to examine. Of its general accuracy there is no doubt, and as far as I have seen, I can confirm most of his views and conclusions. Some points, however, would seem to be questionable. He recommends Poonassa as a desirable locality for establishing iron works, but seems to overlook some facts, which seem to me of considerable importance—one is that the ore used there has to be brought from the Chandgurh diggings, a distance of 15 to 20 miles,* including a passage of the Nerbudda at Sukni Ghât, where the bags of ore are taken off the carts at the top of the high rocky bank, carried down to the boats to be ferried over, and then conveyed up the opposite side and placed on carts, which deliver them at Poonassa. Again, the charcoal is by no means so easily had as on the North bank. Whether the very great increase of expense thus entailed is not counter-balanced by the four reasons given by Mr. Jacob, as influencing him in favour of Poonassa, I cannot pretend to determine, but I think the question worth re-considering. He says, *first*, Poonassa is in British territory; *second*, soil fertile, place healthy, water abundant; *third*, conveniently situated for trade, lime-stone close by; *fourth*, North bank is unhealthy from dense jungle. Of the first I have nothing to say; second, whether the fertility of the soil may be of material importance, I don't know, but think not—it is most true that the North bank is covered with dense jungle and might prove unhealthy, at least during the rains—I doubt however if Poonassa itself be a much more salubrious locality; *third*, Poonassa is I suppose more conveniently situated for trade, but the question ought to be, whether the conveyance of *manufactured* iron to any trading town on the South side to Poonassa itself, from places to the North of the river, would prove a greater disadvantage than having to convey the raw material similar distances as now done.

* Mr. Jacob says 10 miles, and does not allude to the passage of the river.

Mr. Jacob I think looks too favorably on the resources of the "friable ore" or gravel deposit and over-estimates both its superficial extent and depth, for though no doubt "hundreds of acres" are covered by it, yet the radius must be long that will, with Poonassa, as centre, include a large area of it. No doubt Makerabun is an inferior locality, yet if the ore *in situ* could be traced there, it would obviate most of the objections I have to make against Poonassa as a smelting locality; being so much nearer than the diggings which at present supply that place and on the same side of the river.

You will have seen, by what I have already stated, that I take a less sanguine view of the prospects held out at Sonada, and in that part of the coal field than he does. I cannot look on the out-crop than as "indicating a rich mine beneath." I fail to perceive on what grounds Mr. Jacob says that the available coal fields measure 15 miles by 7. They are here more than 15 miles broad from North to South, and towards the West from Sonada they are known to extend at least 150 miles. At Benar he mentions three seams of coal, I saw only two; nor do I think the figures he gives agree with what I saw on the ground; but without noticing what may fairly be called less material points, as far as I have been able to form any fixed opinion, I agree with many of those he expresses, and quite coincide with the favorable view he takes of the mineral resources of the valley as far as coal and iron are concerned.

(Signed) H. B. MEDLICOTT.

Sagur, 14th June.

NOTE.—In the foregoing pages, the terms "coal-bearing" or "coal measure" will have been used, simply as conveying the expression of a certain mineral or lithological character, and not as in any way intended to identify the rocks referred to with the carboniferous epoch of geologists. This question must be determined on other evidence.

No. 34 A.

To

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India.

SIR,

I BEG to forward herewith, for submission to the Hon'ble the President in Council, a Report on the results of my examination of the coal fields of the Tenasserim Provinces during the past season.

In accordance with the instructions of the Most Noble the Governor General in Council, I have endeavoured, within the limits of one season, to form a fair opinion as to the real value and relative importance of the various places where coal is found in these Provinces, and this I have stated in the accompanying remarks.

Our labours were carried on under circumstances of fatigue and exposure, such as few Europeans are subjected to in this country. Owing to the total absence of roads, I had to move about in boats, and frequently in canoes of the smallest size, in which we lived for weeks together. Every supply, both for myself and the coolies, had to be, in all cases, carried with us, often for more than 100 miles. No local aid whatever could be obtained, for frequently there was no human habitation within many days' journey of the places visited. We had to cut our way through the densest jungle, and often climb the loftiest trees to get even an approximate knowledge of our position. It would be difficult to imagine a country less suited for any detailed geological examination. Our time also was short, and I believe we have done as much as was possible under the circumstances.

I am happy to be able to add, that by the exercise of proper precaution, I have been able to keep all my party in good health, notwithstanding their long exposure in the jungles.

From all the authorities in the Provinces we received most ready aid. To Sir Archibald Bogle, Commissioner, I am indebted for hearty co-operation, both previously to, and in anticipation of my arrival, and subsequently; while at Moulmein, the interest taken by Captain Haughton, the Magistrate, in geological pursuits, enabled him to anticipate our wants, and in the most friendly and zealous way to aid our pursuits. From Mr. Stevenson at Tavoy, and Mr. Chase at Mergui, I also received every assistance. Indeed, without the help thus so readily afforded, I should not have been able to accomplish so much as I have done; our

researches, though to a great degree partial, having extended over nearly seven degrees of latitude, or nearly 400 miles from North to South.

In consequence of my having proceeded to Pegu, with a view to the examination of the country about the Station of Thayet Myo, immediately on my return from the field in Tenasserim, some little delay has occurred in the drawing up of this Report, which was under the circumstances unavoidable.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,

Supdt. of the Geological Survey.

Amarapura, }
The 1st September 1855. }

NOTES ON THE COAL-FIELDS AND TIN-STONE DEPOSITS OF THE TENASSERIM PROVINCES.

THE Tenasserim Provinces extend along the Eastern shore of the Bay of Bengal, from the harbour and river of Moulmein on the North to the Pakchan River on the South, embracing a sea-board of more than six degrees of latitude. In breadth from West to East, their extent is nowhere very great, seldom much exceeding one degree of longitude. The Eastern boundary, which separates the British territory from the dominions of Siam, is but little known, and is, for the greater portion of their extent, formed by an interrupted range of mountains, which in part rise to peaks of between 7,000 and 8,000 feet elevation, but the average height of which does not exceed 4,000 to 5,000 in the Northern portion of the Provinces, diminishing to 3,000 and even less in the more Southerly Districts. The main direction of this range is North and South, and the direction of the coast line corresponds with this, for the Northern portion of the Provinces but trends gradually away to the East in passing Southwards. The prevailing direction of the minor ranges of hills, and consequently of the rivers, is also meridional.

The Provinces are divided into three Districts, of which respectively Moulmein, Tavoy and Mergui are the principal towns, all placed on or near to the sea-coast. In the last of these Districts, Mergui, which is also the most Southerly, are situated the coal fields referred to below.

In general geological structure, the Tenasserim Provinces appear to be tolerably simple, although the relation of the rocks at first prove very deceptive, owing to the numerous dislocations and disturbances to which they have been subjected. Resting upon granite, a series of highly metamorphosed rocks occur, exhibiting every variety from perfect gneiss and mica slate to hard siliceous slates, occasionally chloritic, and to black earthy, but micaceous and glossy slates. Through these numerous veins of granite penetrate and ramify in every direction, and of all sizes. These are only seen near to the immediate junction of the granite and the bedded rocks, and where this junction is not absolutely traceable, the occurrence of similar veins points, I think, conclusively to its close proximity.

Resting upon these, there is (in the Southern portion of the Provinces at least) a great accumulation of beds of a pseudo-porphyrific rock, deriving this aspect from imbedded crystallian fragments of felspar, which weather out freely or become whitened on exposure. In its most normal character, this is an earthy, but highly indurated rock, with these small irregularly disseminated bits of felspar; but this passes by almost in sensible gradations on the one hand into hard earthy slaty masses without their disseminated particles, and on the other into grits, containing much rounded fragments of quartz, quartzite, and of these pseudo-porphyrific rocks themselves. These grits often become very coarse, and largely conglomeritic. The intercalation, and occasionally regular succession of these varied deposits, renders the bedding of the series traceable, but the rocks have been subjected to very great disturbances, and are found dipping in every direction and at all angles. These rocks form all the higher grounds of the outer ranges (as distinct from the central range of mountains dividing the British territory from Siam) in the Southern portion of the Provinces, but are only feebly represented in the Northern portion. The general character of the series also varies materially in different parts of the Southern Provinces, the greater or lesser prevalence of grits and conglomerates and of hard sand-stone beds affecting the general aspect.

With this group of rocks, and resting upon it, appear to be associated a considerable thickness of dark-colored blueish and blueish-black earthy beds, frequently thinly laminated, and then presenting an imperfectly developed slaty structure. With these occur some beds of very hard, generally dark-grey, quartzose grits. In parts, apparently from a

greater amount of local igneous action, these slates become silky in aspect and much crumpled. These must be of considerable thickness, although their immediate relation to the rocks occurring close to them are obscure. Taking them in connection with the pseudo-porphyrific rocks, and the conglomerate and grits below, the total thickness cannot be less than 9,000 feet. To these rocks, as being best seen in the Province of Mergui, in all their varied character, I would apply the distinguishing name of the "Mergui" series.

These are succeeded upwards by a group of hard sand-stone beds, often in thick and massive layers, with thin earthy partings—often in thin laminæ, finer and more earthy. The prevailing colour is of a reddish tint, or reddish white tint, but some of the beds are of a deep red, and others of a yellowish earthy tint. A few of the layers are slightly calcareous, and in the upper portion a few thin and irregular bands of earthy lime-stone of a blueish tint occur. In some of the softer and more earthy beds fossils occur (*Corals, Gastropoda, Brachiopoda, Crustacea, &c.*) Over these sand-stones another series of grey shaly beds occurs, these are occasionally calcareous, and when so, yield fossils (*Spirifera, Producta, &c.*) and also pass occasionally into a soft black carbonaceous mass, with nodular concretions of hard quartz. Some beds of sand-stone, often of a dark colour, are associated with this group. Above these come a series of no great thickness (150 to 200 feet) of fine soft sand-stones, thinly bedded, and with grey and pinkish-colored shaly layers intercalated; and upon these appears to rest the hard and thick lime-stone of the District, as seen near the Tenasserim River and in the Southern part of the Provinces. This lime-stone is the representative of the great lime-stone which is seen so largely developed near to Moulmein and in the Province of Amherst, but which is, comparatively speaking, sparingly present in the South. Its relation with any overlying rock I cannot state.

The whole of these form one continuous series, and as some of the most important members of that series are best seen in the immediate vicinity of Moulmein, I would designate the group the "Moulmein" beds.

These Moulmein beds, and down in the succession I have given to the top of the Mergui group, appear to me, so far as I can at present judge, to represent the same general geological epoch as the lower carboniferous group of European geologists. The era of the "Mergui" rocks them-

selves is not so clear. In many cases, pseudo-porphyrific beds have much the aspect of some of those curious and interesting igneous masses, which are so common in the Siberian Districts of England ; while others of the coarse and hard, and often almost corneous sand-stones and conglomerates have all the lithological character of many of the European Deonian series ; but as yet their lithological character is the only evidence, as I could not trace any organic remains which could give a clue to their geological epoch—I have given their average thickness above as 9,000 feet ; but when most largely developed, they are at least 11 to 12,000. The total thickness of the “ Moulmein ” group above, exclusive of the lime-stone, is about 5,000 feet, and the lime-stone itself (near to Moulmein) has a thickness perfectly seen of some 1,100 feet.

This lime-stone is by no means deficient in fossils, but is, in general, so hard and compact, that it is entirely impossible to get any of the imbedded organic remains out. On the weathered surfaces, and smooth water-polished faces of the rock, their outlined sections can be traced, worn down perfectly smooth with the general surface, but any attempt to break them out inevitably results in the fracture of all. In the caves near Moulmein, hundreds of these can be seen, and I can scarcely fancy how many previous observers can have repeated the statement that this lime-stone was non-fossileferous. Probably, if this rock were anywhere quarried, some of these organic remains could be procured, but unfortunately, here as elsewhere, one of the great difficulties a geologist has to contend with is the total absence of any openings or quarries into the rocks of the District.

Upon the denuded surfaces and edges of the rocks hitherto described, we find a series of beds of conglomerates, of sand-stones, of soft and loosely coherent shales, and of *coal*, which stretch at intervals over a very large portion of the Southern part of the Tenasserim Provinces. The conglomerates are never very coarse, the pebbles seldom exceeding a few inches in diameter ; the sand-stones are fine gritty and pebbly, clean white quartzose sands, or earthy and of a yellowish tint ; the shale beds are of a blueish-green or blackish tint, and very regularly disposed in thin and frequently repeated laminae. The coal itself is also regularly disposed in thin flaky laminae, with minute earthy streaks marking its structure.

Besides their unconformability with the lower rocks, and the difference in mineral character which these beds offer, there is a total difference in

their imbedded organic remains. In some of the layers of the soft sand-stones and shales numerous impressions of dicotyledonous leaves are found, of a very recent aspect, and in the beds of papery shale which accompany the coal (like much of the papery brown coal of Germany) are numerous fish scales and bones (but seldom any thing like a perfect fish) of fresh-water character. All these circumstances combined point to a very recent geological epoch for the formation of these beds, and I have no hesitation in entirely agreeing with the opinion on this point formerly expressed by Colonel Tremenheere, that these coals are of the tertiary period of geology. The reasoning which led the "Coal Committee," in their Report for the year 1845, to arrive at a different conclusion, I cannot follow. "There cannot, however, be a doubt as to its belonging to the true coal formation, both from the nature of the coal itself, as well as of the beds with which it is associated," is the statement of the Committee (page 137,) but the usefulness of lithological character alone to determine the geological age of any rock is well known.

It is an interesting and curious fact, however, that in this District there is a very considerable development of rocks, which, from their imbedded organic remains, are certainly of an age somewhat synchronous with that of the great "carboniferous" formation of geologists, but in which no beds of coal occur; while thick masses of vegetable matter have been deposited, and have subsequently been mineralized into good coal, at a comparatively very recent period. This is only an additional instance of how local all such deposits must be, when compared with large areas, and of how the altered circumstances of each locality must most materially affect the nature of the rock formed there at any given time.

These coal-bearing deposits, the total thickness of which nowhere exceeds 900 to 1,000 feet, are never traceable continuously over any very extended area. They are cut off and seem heaped up against the projecting ridges of the higher grounds and appear to be divided by these natural barriers into a series of isolated and detached portions. In all cases the physical conformation of the country now existing, or a conformation very slightly differing from that now existing, appears to have determined the extent of these deposits, and looking at the general nature of them, and of their associations, I am led to view them as a series of lacustrine (fresh-water) deposits formed in small lake-like expansion along the lines of the great drainage valleys of the country, wherein the waters became ponded back by natural barriers. These deposits also preserve a certain

general direction, and thus mark the line of a great depression, or general valley, between the main dividing ridge which here separates Siam from the British territories and the outer ridges which come between them and the sea. Through and across the line of this outer ridge, the general drainage of the country is discharged by a series of gorges or narrow rocky channels through which the main rivers pass. At Henzai Basin for example, many rivers, the general course of which is North and South, unite and discharge their waters through a narrow gorge of nearly a mile in length. The Tenasserim River, East of Mergui town, in a similar way discharges the large body of waters which had accumulated throughout its extended North and South course, together with the tributary waters of the Little Tenasserim and its affluents, through a narrow rocky gorge; and further South, at the Lenya River, the drainage of an immense area is all discharged through a narrow rocky gorge. All these gorges have a common direction nearly East and West, although the general drainage of the country and the course of the main stream is almost invariably North and South. It is this feature which gives rise to the remarkable and sudden alteration in the direction of these rivers, as may be seen by a reference to a map of the Provinces.

I have not attempted above to do more than merely indicate the general structure of the country, reserving all detail, until the organic remains collected during my visit have been carefully examined.

Passing now to a more detailed consideration of these coal deposits, and of their mode of occurrence, extent and value, I shall first give a list of all the places where coal was reported to have been found.

Previously to my visit to Mergui, Mr. Chase, the Deputy Commissioner in that Province, had been zealously engaged in getting together from the Burmese all the information he could regarding the existence of coal in any part of his District, and the localities where it occurred, and in otherwise making every preparation for my visit. In consequence of these enquiries coal was reported to him to occur in the following twelve places, of which six were then made known for the first time. Dividing these into groups according to their locality, as connected with the main drainage of the country, we have

On the Great Tenasserim River.

Thatay-hkhyoung, (Old coal field worked in 1843.)
 Heinlap, (New.)

Kanmapying, (New.)
 Bankyop, (Known before.)
 Tagoo-hkhyoung, (Ditto.)
 Banpyai, (New.)
 Pawort, (New.)
 Mauton, (Known before.)
 Above the falls, (Mentioned by Dr. Helfer.)

On the Little Tenasserim River.

Tsing-koon, (Thian-khan of Dr. Helfer.)
 Tagit-hkhyoung, (New.)
 Nga-woon-hkhyoung, ... (New. This is a main branch of the
 Little Tenasserim.)

On the Lenya.

Near the head water, ... (Known before.)

Of these thirteen localities, in five, namely, Bankyop, Tagoo Creek, Banpyai, and Mauton on the Great Tenasserim, and in Tagit Creek on the Little Tenasserim, no coal exists; a black carbonaceous rock, with quartz nodules, which crumbles into powder on exposure and soils the fingers, having been mistaken for coal. Of the remaining eight localities, two only were not visited, that on the Nga-woon Creek, to reach which would have occupied so much time as to preclude my being able to visit other and more important places, and the statements regarding the occurrence of coal there were very doubtful, and the Pawort Creek was similarly of difficult and tedious access, while its position above some of the rapids of the Tenasserim River would render it almost impossible to work the coal to advantage, supposing it to exist, which however the structure of the District makes no doubt.

At the locality mentioned by Dr. Helfer "above the falls" of the Tenasserim, the seams were found only an inch or two in thickness, and extremely irregular in their occurrence and frequently discontinuous, so as to be practically quite useless.

There remain therefore *five* localities, namely, Thatay-hkhyoung, Heinlap, and Kanmapying in the Great Tenasserim, the Tsing-koon on the Little Tenasserim, and the Lenya, and these I shall notice in the order in which I have mentioned them.

Thatay-hkhyoung.—Thatay-hkhyoung or creek is the name of the locality of the coal mines which were worked by the Government to some

extent about fourteen years since. The pits were situated about three-quarters of a mile West of the bank of the Tenasserim, and close to the channel of a small stream which here comes down from the higher ridges to the West. The works were abandoned about 12 or 13 years since, and at the time of my visit, were, as was to be expected, filled with water. With some difficulty I was able to get this water reduced sufficiently to obtain a good view of the bed of coal on which the workings had been carried on, and then to examine its structure and arrangement.

The coal had been extracted entirely by means of open adits sunk on the dip of the bed and along the bank of the small stream, in the bank of which the coal was exposed. Shafts had also been sunk at a small distance to the dip of the out-crop and had reached the coal, but I was led to believe that coal had never been raised through them, the workings having been abandoned about the time of the completion of these shafts. Great expenditure had evidently been incurred here, a good broad roadway had been cut through the forest to the bank of the Tenasserim ; this had been levelled by embanking and cutting (in one place a cutting of some hundred yards to the depth of nearly 12 feet,) and also in cutting a long and straight channel of the waters of the small stream, in order to divert them from the workings. Many experimental shafts were also sunk, in search of the bed of coal and of other beds beneath this one, but they appear to have been put down without any proper system, and were for the most part of great size and consequently very costly.

The section of the coal seen here was as follows :—

	<i>Descending.</i> <i>Ft. In.</i>
Surface gravel and clay,	4 0
Stiff tenacious grey clay, with ferruginous markings and coatings on the fissures, which when cut follow the tool and give to the mass a red and ocherey aspect,	6 0
Brownish-black earthy scale, with fish scales and traces of vegetable remain,	5 6
The upper surface, and outer or exposed parts of this, decompose into a clay very similar to that immediately above. For a few inches next the coal it becomes more black—colour, finer shaly and flaky, and the remains of fish are more abundant.	
Rotten coaly matter and coal smut, 9 inches to	1 0
Coal, flaky, compact, highly shining coal; pyrites disseminated in parts; the laminae often marked by extremely thin flaky partings, like thin black paper, and which retain in some cases a vegetable aspect or tissue.	16 6

This coal, taking it generally, has a total thickness of 11 feet $8\frac{1}{2}$ inches, if in this be included all the small and thin partings of earthy matter which occur. In detail the section is as follows :—

	<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>
Coal, flaky and bright,	2	6		
Brown shale,	0	$1\frac{1}{2}$		
Coal,	0	4		
Greyish-brown shale,	0	1		
Coal, pyrites abundant, much more so than in the upper bed. This is good firm coal, becoming more earthy and flaky towards bottom,	2	0		
Blackish-grey flaky shale as soft clay, imperfect impressions of steam occasionally, thickness to	0	$2\frac{1}{2}$		
Coal, good solid coal pyrites on partings, rendering it "brassy,"	1	0		
Blackish soft coal shale, or earthy coal, shining and full of pyrites,	0	1		
Coal, rich flakes of jet coal of $\frac{1}{2}$ inch, separated by earthy shales, pyrites abundant,	0	10		
Black shaly smut, with thin streaks of coal in it,	0	2		
Alternating and very irregular layers of flaky grey-black vegetable moulded of black jetty coal,	0	9		
Coaly shale, passing into coal,	0	8		
Alternating clay and coal in thin streaky laminae,	0	6		
Grey flaky vegetable mould or clay,	0	4		
Black shale with coal streaks, some of $\frac{1}{4}$ inch thick,	0	10		
Grey clay, flaky, same as before,	0	5		
Shale, with thin bright streaks of coal, flaky and laminae, ..	1	0		
	<hr/>		11	$8\frac{1}{2}$
			<hr/>	
			11	$8\frac{1}{2}$

Under thin covers.

Greyish-white clay (under clay,) flaky and slightly sandy ; small and imperfect remains of plants visible,	3	6
At bottom is more sandy and much harder ; sand-stone much the same color and composition as the bed above, but more sandy,	0	6
Grey soft flaky clay,	0	3
Blackish ditto ditto,	0	2
Brownish-grey, sandy, clunch clay,	1	3
Clay, blueish-grey, soft and flaky, and very similar to that met be- fore, in part,	3	0

Redder and more Ochray.

	<i>Ft.</i>	<i>In.</i>
Sand-stone, reddish white, close-grained and quartzose, with ochray stains; clay, hard, stiff, tenacious towards base, more ferruginous and sandy,.....	5	0
Sand-stone, ochray and quartzose, decomposing into a yellowish ochray sand,.....	4	0
	<hr/>	<hr/>
	29	4½

The beds below this continue to be of a similar character, hard quartzose sand-stones for some depth, but no coal has been observed in them. Over all the beds noticed above a thick mass of conglomerate was found in sinking one of the shafts to the dip of the coal.

From the detailed section I have given above, it will be seen that the actual coal seams amount together to 6 feet 8 inches in thickness, while the intervening partings of shale, &c., only form an aggregate thickness of 4½ inches, so that the whole could easily be worked in one bed; and this was done.

The dip or inclination of all the beds is high, being as much as 28° towards 15° N. of E. There is a distinct jointing in the masses heading a little E. of North, at the planes of which underlie 60° at 70° to the West.

Throughout the whole thickness of the coal, iron pyrites appears, either imbedded in small lumps, or forming their crystalline coatings on the joints, often giving the coal, when freshly broken, a richly glistening metallic appearance. The coal, I was informed, turned out in good cuboidal masses, was easily wrought, and with little waste. It is difficult to ignite but burns freely, breaking up into small fragments, which do not intermine, or coke, and in large heaps requires care to keep up free ignition. It was found to answer well in the small steam engine used at the mines and also proved equal to ordinary "country" coal in sea-going steamers.

The presence of the iron pyrites mentioned above, to which, whether justly or not, was attributed the fact of some of this coal having spontaneously ignited on one or two occasions, would undoubtedly tend to render this coal unsafe; but I do not think that this alone would have been sufficient to condemn it, as this mineral is by no means constantly present, and much of the coal is so free from it as to be perfectly safe and useful. The waste at the mine would further be a productive source of alum, if economized in that way.

The rapid dip of the beds, and the consequent depth to which all shafts would soon have to be sunk to meet the coal, was, in my opinion,

and still remains, the most serious objection to the profitable working of this coal. In other respects it is well placed. The distance from the pits' mouth to the Tenasserim River is not more than three-fourths of a mile, and for the whole way a level road has been formed, on which it was intended to lay a tram-way.

At the time of my visit (February) the waters of the river were very low, though not at the lowest; but there was then, and I should think at all times of the year, a very tolerable supply in the small stream passing the coal pits. This could readily also be founded back above the coal and a reservoir formed, from which a steady supply could be obtained. The amount of water was quite sufficient for drawing a very effective water-wheel, and I am disposed to think that such would have been both a much cheaper and more useful process than simply diverting the stream as was done.

Heinlap.—The next locality on the Great Tenasserim River, in which coal has been found, is Heinlap or Heinlat. This is the name of a small scattered Burmese village, located on the right bank of the river, about 6 miles further North than Thatay-hkhyoung. The coal beds crop out at the Eastern side of a small mountain stream, about three-fourths of a mile to the West of the bank of the Tenasserim. The country between the river and the coal is at present an unbroken jungle, but it is tolerably level, and presents no real difficulty to the formation of an excellent road. The difference of level between the river bank and the coal, where it out-crops, is very trifling. The occurrence of coal here was made known to Mr. Chase, Deputy Commissioner at Mergui, by some natives who had seen it in their wanderings among the jungle. It was not known at the time of the works being carried on at the old mines, and indeed very probably was not then visible, as the stream may since then have cut away the bank and exposed it.

The section immediately at the coal gives the following succession:—

Blackish compact flaky shale or slate, abounding in small fish scales,	
bones, &c., same as those found at Thatay-hkhyoung,	4 0
Ditto, more pitchy-looking, with thin laminae of bright coal,	0 6
Coal smut or dirty earthy coal,	6 inches to 0 9
Coal, flaky in structure; this separation into laminae being well seen on exposed surfaces, but scarcely visible on the fresh fracture; the coal breaking as readily across these lines as along them; very thin divisions of more earthy and flaky character mark some of the layers; but do not occur in sufficient thickness or number to prevent the whole bed being removed.	

The coal is here not less than 17 feet 6 inches to 18 feet thick. From top to bottom of this splendid bed there is but little variation in quality, all is of good glossy aspect and conchoidal fracture, coming out in large and symmetrical masses, which do not, however, bear exposure for any length of time without breaking down. It burns freely, and with a good flame, does not coke, but breaks up, and leaves but little ashes.

Throughout the bed a few small lumps of iron pyrites, and a few thin coatings on the joints, occur, but not to any extent, and by no means so abundantly as in the coal at Thatay-hkhyoung, or at Kanmapying, (to be described below,) nor do I think to any extent sufficient to prove objectionable in the use of the coal.

The specific gravity of this coal is 1.28, and by analysis 100 parts were found to contain

Volatile matter, inclusive of water,	54.6
Carbon,	45.4
Ashes,	6.5

The water was found to be 12.6 per cent.*

From this place, under the sanction of Mr. Chase, from 70 to 100 tons of coal had been extracted by a Burmese, and brought to Mergui, from which it was supplied to the H. C. Steamer *Pluto*, and proved a very effective and useful coal, keeping up steam well and easily fired. It is, as might be anticipated, of rather rapid combustion, and would be more adapted for tubular boilers than for those of the ordinary construction.

The coal was extracted simply by cutting back on the face of the outcrop, and in doing so only a thickness of about 13 feet of the coal had been touched, the rest being left as not so easily accessible. The cutting extended for about 7 yards in length, and had, therefore, not been carried to a depth of more than 12 feet. This was all filled on my arrival with water, and had to be all cleared before I could see the coal or its relations.

Under contract, the Burmese, who excavated here, received Rupees 24 for every ton of coal delivered at Mergui—a rate which, however desirable it may have been to encourage such undertakings at first, was very much too high to be maintained:—indeed the same man was most desirous of entering on another contract, for the delivery of coal at Mergui, at Rupees 16, or a reduction of one-third; but even this I consider was

* This analysis, and those given below, made by Dr. F. N. Macnamara, Chemical Examiner to the Government, are given on his authority.

too high a rate. Seeing, however, that in any case the amount of coal which could be procured in that way, without any machinery, or any of the most ordinary mechanical appliances, could only be small, and that every yard thus excavated was only tending to injure the mine, if any systematic workings were contemplated, I advised that such operations should be stopped, and no more coal has therefore been extracted.

Kanmapying.—Reserving for the present all consideration of a practical nature, I shall briefly describe the other localities. About three-quarters of a mile North of Heinlap another small village is situated in the jungle on the West bank of the Tenasserim, and within its lands coal has been found, exposed by the cutting back of a small mountain rill. This coal at Kanmapying is of very similar character and aspect to the others. Its analysis yielded to Dr. Macnamara the following results:—

Specific gravity,	1.33
Volatile matter,	54.2
Carbon,	45.8
Ashes,	3.5

The water included above in the amount of volatile matter was 10.5 per cent.

Iron pyrites is unfortunately very abundant in this bed of coal, and would render it an unsafe fuel for many purposes, from the danger of spontaneous combustion. For local purposes, however, it would prove a very useful fuel, the more “brassy” portions being rejected, and for such purposes a large amount of good coal might be here obtained.

It is not well seen, and the section is rather obscure. Covered by blackish shale, with some fish scales, &c., we have a bed or layer of slaty or lamina coal of 2 feet 8 inches in thickness. This rests upon a tough reddish-brown flaky clay, with carbonaceous partings of 11 inches; then a 2-inch seam of pale clay, with carbonized impressions of grassy stems; then 4 inches of carbonaceous and bituminous shale; then 1 foot 5 inches of ashy-colored clay, with carbonaceous markings. Under these is the main bed of coal, which here gives a workable thickness of about 8 feet, divided by some thin layers of earthy shale, but yielding large and symmetrical masses of coal.

This coal is at a slightly less distance from the river than that at Heinlap; the path through the jungle, cut nearly straight, is 1,090 yards in length, and over very easy and favorable ground. The points where it meets the river is, however, by no means so favorable as a shipping place near

Heinlap, where there is deep water and a firm solid bank held up by thick beds of conglomerate, which are here horizontal, and projecting from the bank, form in the dry season an excellent natural landing place.

Still further to the North, on the line of the Great Tenasserim coal, was reported, as occurring on a small stream, which comes from the West past the village of Pawort; but the story being very confused, the evidence very doubtful, and the distance said to be three day's journey up this nullah, which is only passable for the smallest canoes for one day's journey, so that the coal, even if it existed, would be practically inaccessible. I did not waste the short time at my command in visiting the locality—indeed I do not think it at all probable that any coal would be found there, judging from the general structure of the country.

Coal, as stated by Dr. Helfer,* also occurs at a considerable distance North of this and above the great rapids of the Tenasserim. This was visited by my colleague, Mr. Theobald, who found that it is in small nodular strings in the sand-stone, not more than an inch in thickness, and by no means continuous. These are, therefore, of no practical value whatever.

Little Tenasserim River.—The Little Tenasserim River joins the Tenasserim at the town of the same name, formerly the principal town of the Province. From its junction, its course is in a South-easterly direction and very tortuous for about 15 miles, when it assumes a general or North and South direction, but with many marked windings. At 24 miles to the South of Tenasserim town, or about 35 by the winding course of the stream, the waters of the Tsing-koon, a considerable stream coming from the East, unite with the Little Tenasserim, and to this distance the latter river presents no obstacle to navigation, being for a large proportion of the way subject to tidal influence.

The glowing descriptions given of the coal found in the upper waters of the Tsing-koon (or Thian-khan as Dr. Helfer spells it) had led Mr. Chase to incur considerable expense in preparing for my visit. He had himself, some two months previously, attempted to ascend the stream, but was stopped by large fallen trees, and had therefore despatched a party of men to clear the channel of the stream and to erect *zayats* or resting-houses at convenient distances up its course. Although the Burmans, judging of our rate of progress by their own very slow habits,

* Second Report, 1839, page 36.

had erected several more of these than were required, the precaution of having the course of the stream partly cleared was very essential. Even after all that had been done, it was in many places just possible to get through with the smallest-sized canoes : in some places channels had to be formed in the stony rapids, by turning all the men to remove the loose lumps and pile them up on either side, so as to form an *ex-tempore* channel, up which our canoes could be forced : in other parts they had to be lifted bodily over fallen trunks of trees—in some to be forced under those but slightly elevated above the water. In short it would be difficult to imagine a stream which could (for one-half at least of the entire distance) offer greater impediments to an easy and open navigation. Our boats were canoes of the smallest size, in which more than three men could with difficulty be put, and for any larger boats, it would have been altogether impracticable. No doubt during the monsoon many of these impediments would disappear, but if ever this Tsing-koon stream is to be made a highway for trade, a large outlay will be requisite to clear its channel in the first instance, and a considerable annual expenditure to keep it clear. This arises from its banks being composed throughout a great portion of its course of soft sandy clay and sands, thickly wooded to the very water's edge, with large and well-grown timber. The banks, being gradually undermined, many of these fall in during every season, and for a time most effectually close up the stream against the passage of any boats. Up this stream, accompanied by Dr. Chase I proceeded for five long days' journey (from Tenasserim,) and then leaving the canoes, marched about 11 miles further through the forest, until I reached the locality of the coal.

Dr. Helfer first discovered and described this locality in 1848, and then spoke of the coal in the following terms :—"A vein, 5 feet thick, " 240 feet long, visible on the banks of the river, formation above grey, " below black clay slate, the lowest stratum apparently resting—to judge " after the general features of the country—upon blue lime-stone;" and again, " close to this, and a continuation of it, an immense coal field, of either " slaty or conchoidal pitch coal, or English cannel coal, highly bituminous, without any concomitant of iron pyrites." He states the seam to be in most places 6 or more feet thick, and dipping 25°. This locality is said to be 121 miles from Mergui, or from the town of Tenasserim 80.*

* Dr. Helfer's Second Report, Calcutta, 1849, p. 37, &c.

It is exceedingly difficult to understand Dr. Helfer's account of this coal, as he always speaks of it as cannel coal and pitch coal, and yet says it would rank next to Kilkenny coal, which is well known to be an arithracite, or in fact at the other end of the scale altogether.

The Reports of the Coal Committee in 1846 even went further than Dr. Helfer, and spoke of "inexhaustible beds of uniformly good quality" (p. 142.) I was therefore greatly disappointed, on coming to examine the place, to find that all these fine descriptions were, as far as I could see, quite unsupported by facts. There is undoubtedly a bed of what at first might readily be mistaken for coal, of 6 feet thick, and seen in more places than one; but of these 6 feet, there is in reality only a few inches of good coal; the rest is very earthy bituminous shale, with thin streaky laminæ of coal, barely sufficient to support ignition, and uncertain combustion; and even the coal, which does occur, is irregularly distributed in lenticular nodules or lumps imbedded in the general earthy mass, and having often very much the aspect of being the result of the thorough carbonization of masses of wood imbedded in the general heap of vegetable pulp and leafy mud.

There are two distinct beds, separated by an intervening series of sand-stone and shales of about 200 feet in thickness—of these beds, the upper one is decidedly the best, and from its total thickness (6 feet) I suppose that about 2 feet of tolerable coal could be obtained.

The detailed section of the coal beds and associated layers will show their character. The lower bed gives

	<i>Descending.</i> <i>Ft. In.</i>	
Clay and gravel on top,	10 to	12 0
Mould, blackish,	0	6
Ditto, red,	0	4
Coaly smut, earthy and ferruginous,	2	0
Coal, flaky, woody in structure,	0	4
Clunch clay, grey, flaky, with fragmentary vegetable impressions, abundant and irregular, thin streaks of bright jetty coal—lower 3 or 4 inches much lighter in color,	1	0
Coal, brilliant jetty coal, bright and glistening, in places 1 foot thick, but dying out to nothing within a few feet, and then again enlarging to 8 or 10 inches, very irregularly streaked with blackish shaly clay,	1	0
Grey clunchy clay, with many irregular seams of brilliant jetty coal, ..	8	0

Thus out of a bed or beds which on surface look like a bed of coal of more than 4 feet thick, there is in reality not more than 18 inches, frequently much less, of good coal, and this not in a continuous deposit, but in irregular patches.

At the upper bed the detailed section is

	<i>Descending.</i> Ft. In.
Black coaly shale,	2 0
Coal and coaly shale,	1 1
Shales, brownish-black and papery, with fish scales, &c.,	0 7
Coal, bright and good, but with iron pyrites disseminated,	0 4
Shales, blackish, with thin laminae of bright jetty coal,	1 5
Coal, fair strong coal, laminae in structure (pyrites,)	3 0
Clay, grey flaky clay,	—

Here it will be seen that there is more than 3 feet of fair coal, which is however, though not largely, impregnated with iron pyrites.

The analysis of this coal yielded to Dr. Macnamara the following results :—

Specific gravity,	1·37	Per-centage of water, 16.
Volatile matter,	49·7	Inclusive of water.
Carbon,	50·3	
Ashes,	8·5	

With the exception of the iron pyrites, this is a good fuel. It comes out in good lumps and is sufficiently hard. The greater portion also of the coaly shale given in this section might be usefully economized for any local purposes, if ever this field should be wrought, but is too poor to repay the cost of transport to any distance.

These beds are favorably placed for working, the amount of the dip or inclination is not more than 18° to N. 20' E., and they are very accessible so far as their position with regard to the stream and the surface is concerned, but I am satisfied that the great distance of the place from any port, the very bad state of the small stream down which the coal would have to be conveyed, and the consequently heavy expense of carriage, will preclude these Tsing-koon coals from being worked, so long as other and more easily accessible localities can be found.

The village of Tsing-koon, or rather the site of the old village now marked by a few scattered palm and a ruined pagoda, near to which are some large clearings, is about 6 miles further down the stream than the coal. Just behind or North of the point where the coal is seen in the stream, there was another village similarly marked, some detached fruit

trees and clearings in the jungle, and which was called NOUNG-bwa ; and passing through the jungle in other directions abundant evidences are met with of how closely populated this District must once have been. At present not a human habitation is to be met with more than a couple of days' journey from Tenasserim Town in this direction.

About 5 miles in a right line below Tsing-koon* the river or stream which, above this, is only passable for rafts even in the rains, becomes deeper, and from that downwards small boats can proceed during the monsoon, and from the junction of the Tsing-koon and Nga woon streams, which together form the Little Tenasserim, larger boats can be navigated.

The position of this coal was at first supposed to be within the territories of the King of Siam. This was however shown to be an erroneous impression by Major McLeod, who visited the place ; and I marched across to the boundary myself and found the water-shed of the central range of mountains, which is universally acknowledged as the boundary, to be about 12 miles almost due East from the coal. There is a path across here into Siam, and I met several people going and returning. The pass along which it winds does not attain any great elevation (not more than 650 feet above the sea,) but the hills on either side rise considerably higher (2,000 with points 3,000.)

Lenya River.—Returning from the Tsing-koon, I visited the Lenya to see the coal fields reported to occur there. Proceeding by water from Mergui along the coast Southwards, we entered the five estuary of the River Lenya, and passing up to the village of that name, exchanged our larger boats for small canoes as before and started up the river, the general course of which here is nearly North and South. After five long and heavy days' work, frequently having to lighten our canoes and pull them up the rapids, in one place having to cut a regular channel through the sand in consequence of the stream being totally blocked up by fallen timber, we reached the locality where the coal had been found. After passing A-tong-wa, about 8 miles above Lenya village, not a single human habitation was to be met with ; a few small canoes and a few scattered watch-fires along the bank marked the resting place of the hunter or the rattan-gatherer.

* On leaving the river here, we marched for some miles along an old and regularly formed road, cut along the slopes of the hill-sides, and which is traditionally known as Alamprar's royal road. It is said to have been constructed by his order for the passage of his army when contemplating the conquest of Siam.

The coal is here exposed in the bank of a small tributary stream, which comes in from the South, and which is called by the natives the Phlia-o or fish stream (Siamese name.) It occurs in an irregularly developed bed, varying from 1 foot to 2 feet and even 2 feet 6 inches in thickness. It is throughout of laminar structure, with their seam of fine jetty coal between the layers and very numerous nodular lumps and masses of a resinous ambery-looking mineral imbedded; the mass of the coal on the fresh fracture iron a very dull lustre and hard pitchy and earthy aspect. The whole group of rocks here has even a more modern look than the beds with coal in the Tenasserim District. The rocks are softer and less indurated, and are more irregular, and more like recent clays and sands.

In ascending order the little section of the coal here exposed is as follows:—

	<i>Ft. In.</i>
Blueish-white, grey, and blackish fine sandy mud, with small black patches or stains, evidently the indistinct remains of plants, (seen,) 3 0	
This passes insensibly into a dark brownish bed of the same kind, with small angular grains of quartz imbedded, and this by insensible gradations becomes of a blacker colour from their streaks of coal matter and small fragments of carbonized vegetable remains. This does not form any definite bed, but is only the upper part of the previous beds, with these slight alterations in texture and composition, 2 8	
Coal resting on the irregular surface of this muddy bed,..... 1 6	
Mud, clunchy and full of disseminated vegetable remains in rather fragments of carbonized vegetable matter, forming black layers and patches, varying from an almost imperceptible thickness to $\frac{1}{2}$ an inch, 4 0	
In this bed are imbedded irregular patches of brilliant jet coal, with a bright lustre, and having a semi-columnous texture. One mun of this extracted yielded a basket of fine brilliant blazing coal; on the outer portion of this the woody structure was quite visible.	
Coal, fine bright pitchy coal; in their seams varying from $\frac{1}{2}$ of an inch to 1 inch, imbedded in ferruginous mud, 0 10	
Mud, fine silty greyish white, with stems and leaves disseminated through it in every direction, both across and along the layers, but slightly carbonized, 4 6	
Black ferruginous bed, with small nodular masses of the same resinous ambery-looking mineral noticed above and very thin seams of coal, 0 6	

Over all these comes a layer of gravel, composed of pebbles of quartzose hard sand-stone and pure white quartz. In this a few small fragments of tin-stone occurs. This gravel is here from 6 inches to 2 feet

6 inches in thickness, and is covered by the stiff-red pseudo-latenti clay, so commonly exposed over the country.

The beds of coal and associated rocks dip at 35° to 38° to E. 15° to 30° N.

Such is the section in immediate connexion with the coal. Below these beds the series of rocks consists of (similarly ascending) of whitish earthy fine sand-stone and indurated mud, slightly calcareous, occasionally and locally so much so as to form a muddy lime-stone. To these succeed beds of partially angular conglomerates, with beds of clunchy clay and muddy sand-stones, dipping as before to E. 30° N. This series is about 300 feet thick. By "partially angular" I mean conglomerates in which the angular character of the broken pebbles imbedded is still retained, although the sharp edges are slightly worn off. Over these comes the coal group as given above, and above this again we have a series of sand-stone beds, soft and muddy, of thick clunchy clays and marks occasionally pebbly, and with a few seams of unevenly deposited carbonaceous matter of an inch to 2 inches in thickness, and fine pebbly conglomerates. The whole gives a thickness of about 600 feet, and has been subjected to several faultings and other disturbances by which the dip and arrangements have been much affected.

From this it will be seen that there is not altogether more than 18 inches of coal, and this can scarcely be called coal, for it is a hard black slaty shale, somewhat stone coal-like in aspect. It is however very interesting from the abundant dissemination through it in irregular little nodular lumps of the resinous ambery-like mineral I have noticed above. This varies in colour from that of a blueish bottle-green to a rich yellowish tint-like fine amber. In fracture it is quite conchoidal and glassy, burns freely, and from its abundance adds greatly to the glazing qualities of the mass.

Its composition is as follows:—

The coal ignites with some difficulty, but then burns with a good flame and strong heat, the lumps become red hot, but do not disintegrate, retaining all their original form. The ashes are white and abundant. The coal comes out of the bed in large and solid masses, and if it occurred in any abundance would prove an useful fuel for many purposes.

Above this main bed, as I have mentioned, and separated by about 200 feet of sand-stones and clays, there is another thin seam of coaly matter; but it is very irregular and in no place more than a few inches in thickness, so that it will be perfectly useless as a source of fuel.

These are all the localities within the Tenasserim Provinces, where coal has hitherto been found. For the reasons I have already given, any detailed search over the District, with a view to tracing out, by a detailed and systematic examination, the extension of these beds, or to discover any new localities, is at present out of the question. The Nga-woon stream, and the lower waters of the Lenya, are two of the Districts in which new beds might be sought for with some probability of their occurrence, and it might be well to direct the attention of the many native hunters who frequent those forests to the fact and induce them to pay some attention to the discovery and reporting of any seams which may be traceable.

I have above simply described the mode of occurrence of these coals, but I would add a few words as to their relative value, position, quality, &c., and first, as to the facilities for carriage of the coal if worked.

The Tenasserim River is subject to the influence of the tides, which, at the ports of Mergui, rise and fall 18 feet for about 45 miles of its course. At the town of Tenasserim, which is 40 miles from Mergui, there is a rise and fall of 8 feet, but the influence of the tides is not sufficiently great to be of much service in the navigation of the river much beyond this. The distance from Mergui to Tenasserim, or back, can generally be made easily in two tides. For several miles above Mergui the banks of the river are low and covered with mangrove swamps. The delta extends for nearly 20 miles North and South and is intersected by numerous channels, the main stream discharging itself close to Mergui town. In this portion of its course, it is a fine broad open river, with abundance of water for boats of all sizes and for all purposes of inland navigation, and this at all seasons of the year.

Above Tenasserim town, the course of the river, which from Mergui is S. of East, suddenly changes to nearly North and South, and for the greater portion of its course hold this direction in the main. The Little Tenasserim River joins the larger stream from the South at the town of Tenasserim, and above this the depth and quantity of water materially diminishes. As far however as the village of Banlan, 7 miles from Tenasserim, there is no impediment to the free navigation of the river by small boats; above this many sand banks occur, and in several places gravelly ridges cross the channel, which cause small rapids, but in no case is the fall of any extent, or the increase in the rapidity of the current serious. The beds of these shoals are in all cases loose sand or

gravel, and can easily be moved. At the time of my visit (February) the waters were low, though not at their lowest, but the smallest depth of water I found over any of those shoals was 1 foot 10 inches. In the intervening levels, there were, with few exceptions, more than 3 feet. After February, and up to the end of the dry season, the river may probably fall about 1 foot more, so as to reduce the minimum depth to a little less than 1 foot ; but this minimum depth only occurs during one month of the entire year, as the rainy season commences much earlier in these Provinces than in Bengal.

The rise of water in the river during the monsoon is often very great. The highest mark of the water line which I could trace at Heinlap was 31 feet above the then level of the water surface, but this great rise can only be occasional and of short duration, the line, marking the more continuous level of the summer stream being only 22 feet above the same point. There is therefore at all times sufficient water in the Tenasserim River to float down bamboo rafts, and for nine or ten months of the year sufficient for barges or lighters properly constructed. This river is not subject to those sudden and destructive floods, which in other streams often cause so much devastation.

All the coal which was formerly extracted from the pits at Thatay-hkhyoung was sent to Mergui on bamboo rafts—of bamboos the supply in the neighbourhood is practically inexhaustible for many years—and this was certainly as economical a plan as could have been adopted ; but it is open to the serious objection that the coal thus despatched is generally partly immersed in the water, and so becomes thoroughly wetted. For many hours it was thus exposed to the action of sea-water, and the dangerous effects of such exposure to salt water, with coals containing iron pyrites, as these do, is generally admitted.

The time occupied by the rafts, in going to Mergui from the mine, was generally four to five days. After discharging the coal these rafts were broken up and the bamboos sold, the amount realized from their sale being credited against their original cost. I am satisfied, however, that this plan, although undoubtedly economical, must be abandoned, if these coals be largely worked, probably for the whole distance, but certainly for the lower and tidal portion of the transit.

The three localities I have described, where coal is found on the Great Tenasserim, are so near to each other, that practically the expense and time of transit may be considered as the same for all. During former

operations this transport of the coal was carried on by contract at the rate of 2 annas 9 pie per maund, including the carriage by coolies from the pits' mouth to the river, or for a little less than Rupees 5 per ton. More than one-half of this cost was for the land carriage from the pit to the water's edge, and this would have been to a great extent saved by the construction of the tram-road as contemplated.

The distance from the river bank does not materially differ in any of the three localities. The out-crop at Heinlap, measured along the path through the jungle, which is nearly straight, is 1,291 yards from the river; that at Kanmapying, 1,050. For the whole distance at Thatay-hkhyoung, as I have already mentioned, a level road has been formed and prepared for laying down a tram-way. The country in each of the other localities is well adapted for such a construction, and the cost would be small. There is abundance of timber in the immediate vicinity well suited for all the purposes it may be required for. With reference to the quantity of coal which may exist, I am disposed, after the best examination which the nature of the country would permit, to think that the coals seen at Thatay-hkhyoung and at Heinlap are the out-crops of one and the same bed, which varies in character and in thickness. I am led to this opinion by the general similarity of the section seen at these places. Thus, at Thatay-hkhyoung, although only 6 feet of coal was worked or workable, the seams of jetty coal continued to a total thickness of nearly 18 feet, while at Heinlap the whole of this thickness was of good coal. There is a marked similarity in the beds of shale holding fish remains, forming the roof of the coal in both places, and the general accordance of the group of associated rocks confirms the idea. The coal seen at Kanmapying may come in above the Heinlap coal, and if so, be separated from it by about 160 feet of sand-stones, clays, and shales, or it may be only the prolongation of the same bed, slightly faulted. To prove this definitely, expensive and tedious borings would be required, and these I did not consider justified under the circumstances, inasmuch as the result would not affect materially any workings to be commenced in the District, while the progress of the workings themselves would decide the point.

Assuming therefore that we have exhibited in these out-crops one and the same bed, and that this bed varies in thickness between the two extremes of 18 feet and 6 feet, we may fairly estimate its average thickness as 12 feet or 4 yards; and looking at the specific gravity of the coal,

we may equally assume 1 cubic yard as equal to 1 ton weight. Such a coal then would yield per statute acres 19,360 tons, while the area over which the bed may justly be presumed to extend is not less, and probably much more, than 3 square miles, or 1,920 statute acres. But the angle of inclination at Heinlap being, as I have stated, so high (38°,) it becomes necessary to estimate the amount of coal which may be accessible with ordinary means, rather than the quantity which actually may exist.

A shaft sunk at 50 yards distance from the out-crop to the dip of the coal would reach the bed at little more than 40 yards or 120 feet from the surface, and would command a depth measured along the bed itself of about 65 yards. Now such a shaft, judiciously put down, would enable at least 250 yards on either side of it to be won. This would therefore give $65 \times (250 \times 250) \times 4 = 1,30,000$ cubic yards or tons of coal. Estimating the amount left in the workings for supports, &c., for waste and loss, as one-third of this, there would still remain nearly 87,000 tons to be obtained. Another shaft, or pair of shafts, sunk at an equal distance on the dip of the bed, would again command as much more; these new shafts being double the depth, or nearly 250 feet, that is, that from shafts of 250 feet in depth, there ought to be procurable 174,000 tons of coal.

For such workings, steam engines and all other appropriate machinery, pumps, &c., would be requisite. I think water power might be, to a considerable extent, available for drawing the coals at least for a considerable time, reserving the steam power for unwatering the mine.

The extent of surface, or horizontal distance along the out-crop, from which the coal could be wrought, is fully $1\frac{1}{2}$ mile, so that there does not appear to be any reason for anticipating a deficiency of supply, or any want of coal within a reasonable distance from the surface; and looking to the future workings of this field, it should be remembered that an examination of the adjoining country shows that the beds with which this coal is associated; and therefore we presume the coal itself have a much lower dip towards the East than along their Western out-crop.

The costs at which the coal could be raised remains to be considered.

At first, and before the workings had reached to any depth, the facilities for the extraction of the coal would be great, and it ought easily to be hewn and raised for one Rupee and a half per ton, or Rupees 2. After

that the expense would considerably increase, but even then I am satisfied Rupees $3\frac{1}{2}$ or Rupees 4 per ton would cover the expense of hewing and winning. To this add 25 per cent. for expenditure in general work, and the cost of the coal at the pits' mouth would be about Rupees 5 per ton. The cost of transit to Mergui, (taking this at the high rate originally paid, namely, 2 annas 9 pie per maund, or Rupees 4-13 per ton,) added to this, would make the total cost of the coal delivered at Mergui Rupees 9-13 or Rupees 10 per ton, or less than 6 annas per maund.*

In the old workings at Thatay-hkhyoung convict labour was largely employed, but I have not above contemplated any continuation of such an arrangement, which would not, I feel confident, be found desirable under any circumstances. A considerable outlay would be requisite, but the return would be immediate, and the extension of the machinery gradual. Indeed a considerable amount of coal might be obtained without any but the most ordinary machinery.†

On the whole I think this small coal field offers a promising and encouraging prospect of coal, of fair average quality, procurable at a reasonable cost and in sufficient quantity to be commercially valuable.

It does not appear necessary to enter into any details as to the proper mode of working this coal, or into any question as to the agency by which the works, if undertaken, should be carried on. Such discussions would be out of my province or premature.

The coals on the Little Tenasserim, or rather on the Tsing-koon River, do not, as I have already stated, appear to me to occur in sufficient quantity to justify any great outlay at present in working it. The distance from the port is great, the stream itself is very shallow and small, full of impediments, and for nearly five months in the year almost useless for any purposes of navigation; and to be rendered available at all would require a very large primary outlay, and a considerable annual expenditure. I shall therefore not enter into any further details regarding it.

* The present (1855) price of coal at Moulmein is more than double this, and a few months back, was more than four times this sum.

† If we suppose primary outlay of Rupees 50,000 (which ought to be much more than sufficient to place this coal field in good working order,) and take the interest on this sum at 15 per cent. this would give an annual charge of Rupees 7,500. If 150 tons of coal were raised per week, and 50 weeks be taken as the working year, this would add exactly one Rupee to the cost of each ton.

Similar remarks will apply to the coal on the upper waters of the Lenya. It is to be regretted that this coal did not prove of better quality and more abundant. The entrance to this river is more easily made from sea than the port of Mergui, and the river is itself a fine open stream. Its geographical position also further to the South makes it a more favorable situation for the supply of the Straits, &c., than Mergui, but there appears to me no reason to hope for any large deposits of good coal in this vicinity.

All the other localities have been already noticed.

But the greatest mineral wealth of the Southern portion of the Tenasserim Provinces consists in the extensive and valuable deposits of tin ore which they contain. In the granite of the central dividing range, which separates these Provinces from Siam, and more especially (so far as my opportunities for examination extended) towards the outer edge of this granite or near to its junction with the highly metamorphosed slates with which it comes into contact, tin-stone is an essential ingredient in the mass of the rock, occurring disseminated through the granite in small crystals, similarly arranged to the quartz and felspar of the rock ; and in some cases, as at Kahan hill, near Mergui, veins of granite cut through and traverse the more recent rocks and contain large and abundant crystals of tin-stone.

The principal source of the ore is however in the extensive deposits of "stream tin," where the degradation of the previously existing source has produced a detritic gravel, broken up and washed down the slopes of the higher ground and accumulated in all the flats and stream-courses. So abundant and so widely disseminated are these deposits, that it may safely be said, that from the parallel of the town of Ye Southward to the boundary of the British territories on the Pakchan River, or extending through more than 4° of latitude, the places where, from the physical conformation of the ground, such deposits would be looked for, and where they do not occur, are the exceptions to the general rule.

My time did not admit of my attempting to trace out the boundaries of these deposits or even of visiting many which I should like to have seen, but the general conditions of their occurrence are the same all over the District. Of course there is great variation in the relative abundance in which the ore is found, and in the comparative size of the fragments in

which it occurs (the latter regularly diminishing with the distance from the source of the ore to which the fragments have been transported) ; but there are few of these places in which the working for such ores would not prove profitable.

These deposits have in former times been largely worked, principally, if not entirely, during the period of the occupation of the country by the Shans. In very few cases, even now, do the Burmese wash for tin. In almost every case this is done by Shans, who work either individually, or in company of several who unite to work a certain locality. Where there is this combination of interests, in most cases the work is found to be carried on under the general management of some Chinese settler, who purchases all the tin-stone procured at fixed rates, and furnishes the labourers in return with such supplies as they may require. The few who work separately bring their ore to Mergui, or other towns where it is purchased, principally by Chinamen, and by these is smelted. The metal from these Provinces, with very trifling exceptions, is all exported to Penang, and from thence to Great Britain and other places.

The only extensive workings, carried on under one head, and on any general system in this country, are just beyond the boundary of the British Territory and within the Kingdom of Siam. The Southern limit of British Territory is defined by the Pakchan River, and close to its mouth, on its Southern bank, is the Rhenoung Creek. After a narrow passage through a channel bounded on either side by rocky ground, upon which a settlement of Malays has been located, who act as a kind of frontier police for the District, the creek expands into a wide and open bay, divided by numerous islands covered with mangroves. Turning to the North the small creek leading from this bay to the village soon becomes very trifling in extent, and although passable for small canoes at high water up to the village, is quite dry when the tide falls. The village of Rhenoung itself is beautifully situated close to a range of high and very picturesque hills, and here is the residence of the Governor of the Rhenoung Province or District. He is a Chinaman of great intelligence and ability, and now somewhat advanced in years. The entire Province, as I understood, is held by him under the King of Siam for a fixed revenue, and by far the largest portion of this income is derived from his tin-washings. There was much evidence of great comfort and ease about the whole establishment.

The tin-washings at Rhenoung are situated about 5 miles from the village to the East of the outlying ridge. A mountain stream passes through this ridge in a deep and narrow gorge in the granite, the general direction of the course being East and West, and flows past the village.

At the mines or workings, I found a large establishment of Chinese in full work, busily engaged in making preparations for the coming season of the rains, during which, from the abundant supply of water, the principal operations are carried on. A large and substantially constructed office and store, kitchen, a refectory and work-shops, and sleeping sheds are compactly arranged on one side of the flat in which the washings are carried on. Water-courses intersect the whole of this flat, and the unceasing hum of a water-wheel, with a series of chain pumps, impressed the idea of systematic and well-devised plan of operations, which formed a very marked contrast to the careless and irregular way in which, generally speaking, the ore is sought for in these Provinces. Such a busy scene was scarcely to be looked for in the midst of an unbroken jungle.

The workmen engaged are all regular labourers, who have no other occupation. They go to work and leave off at fixed hours, at the striking of a gong (or wooden drum,) and they are supplied with every thing; their food being all regularly prepared for them at stated times. During my visit I had an opportunity of seeing them at dinner. The supply of food was most abundant, the quality excellent, and the articles of food very varied, and I was asked in the most friendly manner to partake of their well-cooked meal. The entire arrangement evidenced a regular, continuous and systematic employment of labour. About 200 men were thus engaged.

The system of washing here adopted consists in simply throwing the gravel and sand in which the tin-stone is disseminated into a long continuous trough, the bottom of which has a gentle inclination, and keeping the gravel slightly agitated by taking it up gently, while a stream of water passes over it. The lighter and stony portions are of course carried down by the water, and the heavy ores falling to the bottom are subsequently removed and stored. By this system, as here conducted, some of the finest particles of the ore are carried off and lost; but the per-centage is very small, owing to the length of the trough employed and its gradual increase in size and consequent diminution of the force of the stream near its lower end.

The ore thus obtained is all sent in to the village on elephants kept for this purpose, and is there smelted. In the manufacture of charcoal for the reduction of the ore, there is also evidence of the skill of the proprietor. Instead of the open pits in which charcoal is ordinarily made in India, and in the adjoining Districts, here there are regularly constructed kilns for the purpose; and contrasting the two methods of manufacture and their results, I am satisfied that the charcoal thus obtained is 20 per cent. superior to that ordinarily produced in these countries.

At the residence of the old Governor in the village, and within the large palisade, which surrounds his establishment, is a large smelting-house of the ordinary Burmese construction, in which are three furnaces. These are supplied by bellows of the kind common in the Provinces, consisting of a long straight cylinder, or hollowed bulk of wood, supplied with valves at either end, and in which a piston is simply drawn backwards and pushed forwards alternately by manual labour. At the period of my visit, no smelting was being carried on, but the processes here adopted do not differ from those in ordinary use everywhere within the District.

The entire proceeds of these workings, which must be very considerable, although I could not ascertain the exact amount, are despatched to Penang, in boats belonging to the Governor, one of which is commanded by his son, and there sold; all the needful supplies being brought back in return.

I have described these workings in some detail, both because they are, I am sorry to say, the only place I saw where any systematic plan of operations was adopted, or where the smallest improvement, on the most primitive and rude methods, had been introduced. They are also by much the most extensive workings in this portion of the country, although of course trifling as compared with many of those in the Island of Banka and other places in the Straits of Malacca.

Within the British Territory I did not see or hear of any place where the tin-stone is not separated by the primitive mode of washing in a shallow wooden bowl, or dish, by the hand. With this process I satisfied myself by several trials, that when the ore occurred in tolerably large crystals or fragments, the smaller particles were frequently washed away and disregarded, to the loss in some cases of nearly 50 per cent. of the entire quantity; while in other localities, where the ore was in a very

fine and minute state of division, the time and labour involved by the necessary slowness of the process rendered it unremunerative.

Among many other localities where tin-stone is thus obtained within the British territory, may be mentioned

Malee-woon, on a branch of the Pakchan River. There a considerable quantity of tin-stone is procured from a coarse gravelly detritus, chiefly composed of granite pebbles. It is washed over a District of some miles in extent, and is all sold to Chinese settlers in the village of Malee-woon, who smelt and export it. In this District tin, cast into little ingots, in the shape of a frustum of a cone, forms the ordinary currency of the place: they are generally cast into two sizes, which pass respectively for 4 annas and 2 annas; but there is no great accuracy attempted or required.

The washed ore is sold at Malee-woon by measurement. A bamboo, 12 inches long and $3\frac{1}{2}$ inches diameter, is used as the measure, and its contents sell for Rupees 2. In this amount of ore, thirteen of the small 4-anna ingots are said to be contained. The great mass of the ore is made up for exportation in much larger ingots, which weigh on an average 27 lbs., and for the production of one of these, the contents of six bamboos, or Rupees 12 worth of ore, are stated to be requisite. The price of these ingots varies of course with the market price of tin. During four days and four nights' continuous smelting, they state that 50 ingots of this large size are reduced, and that the first charge is sufficiently reduced in one hour and a half to be run off. For this amount 40 baskets, or 40 piculs, of charcoal and 280 bamboos of ore are required.

From the village of Malee-woon alone, from 1,500 to 1,600 ingots of this kind are said to be turned out in each year. The smelting is not carried on at the season during which I was able to visit these localities, so that I could not practically test the statements made to me, but as I found on comparison that the amounts mentioned by one man agreed with those stated by others, without any possibility of collusion, I am induced to think that the quantities given above are tolerably correct. On the average, by their very rude processes, they do not obtain from this ore at Malee-woon more than 30 per cent. of metal.

At *Pakchan* village, and at one or two other places, in the same District, tin-stone is also procured.

Bokpyen is another centre, from the neighbourhood of which a very considerable amount of tin is annually sent; there also it is principally

purchased in the state of tin-stone, smelted and exported by Chinese settlers.

In many places about *Sadying*, in others along the Lenya River, (as at Mounrung,) and up many of the creeks which fall into this river, and also at the head-waters of the main stream, tin-stone is found. At Mounrung it occurs very abundantly in large-sized fragments and of rich quality, and here there is evidence of the extent to which it was formerly wrought, although now the place is abandoned. Numerous deep cuts and water-courses still remain, and some of good size, although a very small portion of the available field has been trenched upon.

In the valley of the Tenasserim River, and in many of its tributaries, as was pointed out by Colonel Tremenneere in 1844, tin-stone is abundant. It is found along the upper waters of the Nga-woon and of the Tsing-koon, the two main branches which unite to form the Little Tenasserim up many of the minor tributaries of the same river, as the Thabawlick, the Tagit, the Engdan, &c. &c., up the Great Tenasserim in many localities; and towards its head-waters in the parallel of Tavoy, it is said to be abundant. Frequently in the midst of what is now an unbroken jungle, deep pits are met with—old workings, from which tin-stone was formerly procured, but which are now half fallen in.

Close to the town of Mergui, tin-stone is found, but in small quantity, and with it minute scales of gold. At Kahan Hill, about 3 miles from the town, it occurs abundantly in a coarsely crystalline granitic vein, which traverses sand-stone.

Passing Northward from Mergui, tin-stone is met with, although not abundantly along the Western slope of the minor ridge, which divides the valley of the Tenasserim from the sea, and passing Northwards from Tavoy into the District of Henzai, tin-stone again becomes abundant in connection with the outer run of granitic hills, which forms the long promontory, separating the Tavoy River from the sea, and passes Northwards from thence into the Ye District. Here also, as in many other places, gold in minute scales and grains is found with the tin-stone.

In some of these localities, a single family may still be at work, uniting the washing for tin-stone with other pursuits; in others, a few men unite, and during the rainy season, when a supply of water is easily obtained, continue their washings. Of other localities, the knowledge only traditionally exists among the people, and during my rambles the guides who accompanied me, have often been much more surprised

than I was myself, at coming suddenly on old excavations, long since overgrown with jungle.

Among these native workmen no place is considered worth much trouble in working, in which two men, one digging and one washing, cannot readily obtain a viss weight of the washed ore in one day,* although many places not so rich in ore as this are actually worked as occasion may offer. Some localities are traditionally stated to be so rich, that six viss of ore can be procured daily by two men, (as in some of the tributaries of the Lenya,) but the great distance and difficulty of access to such places, and the constant necessity where no proper organization exists, of continually returning for supplies, prevent these being visited, excepting rarely and at distant intervals.

So far with regard to the extent of area over which the tin-stone is met with, as to the quantity of the ore, a few words will suffice. I have mentioned the average return which a native workman (a Shan) looks for from his rude mode of washing.

To obtain this quantity of washed ore, the quantity of gravel and sand raised varies very materially in different places, and also depends, in some degree, on the skill of the workman. No average can therefore be fairly given, but it is much more important to know the thickness of the deposits generally.

The section at Rhenoung is thus :†—

	<i>Ft. In.</i>
Clay surface soil and stiff clay, from	2 inches to 2 0
Gravel, chiefly quartz pebbles, much rounded, average size about 2 inches diameter, pebbles of granite, hard siliceous slate, &c., but little sand, no tin-stone,	3 6
Gravel, upper layers fine, passing down into a gravel of about the same coarseness as that above, and very similar in composition, tin-stone abundant, more especially towards centre of deposit,	6 6
Clayey gravel below, not proved. The gravel occasionally rests directly on a hard siliceous slaty rock,	—————
At Malee-woon, the section exposed gave clay, stiff reddish-colored,	4 6
Gravel, chiefly quartzose, occasionally very coarse, with large lumps of quartz and granite, with tin-stone,	5 0

The bottom portion of this, which extends more than 2 feet 6 inches below this depth, is not rich in tin-stone.

* A viss is 3 lbs. 10 oz., about 100 viss being exactly 365 lbs.

† I give this section, although it is not within British Territory, as an illustration of the general character of the deposits.

In the upper part of the Lenya River, the tin-stone bed of gravel is 4 feet thick, under 2 feet to 2 feet 6 inches of sandy clay. At Mourung, under a coating of a few inches to 2 feet of clay and sand, with large blocks of quartz, we reach the tin-stone bed or layer, and which is at least 5 feet thick. In the Tenasserim District the tin-stone layer varies from 4 feet 6 inches to 7 feet in thickness. In the Henzai basin the tin-stone is in places covered with a thick deposit of gravelly clay, sometimes 5 to 10 feet thick, while in other places its surface comes up to the thin covering of soil. In the small stream which passes the village of Om-bin-kuin, the bed of the channel, and its banks, with the exception of the clayey soil above, all yield tin-stone.

These facts are abundant to show, that over a very extended area there is a very large amount of this valuable ore spread, and that in almost every instance, it is readily accessible, being nowhere covered up by any considerable amount of more recent deposits.

A want of a continuous supply of water is in several of the localities I have mentioned a difficulty to be met, before these deposits of tin-stone can be profitably economized, but in most cases a very limited amount of expenditure would suffice to obviate this difficulty. At present nothing whatever is done in this matter. The ordinary streams during the rainy season supply the desultory labour of the untrained workman, and a few months' labour produces him a sufficiency for his support, while the rest of the year is at his disposal for hunting and other pursuits.

With reference to the quality of this ore of tin in the Tenasserim Provinces, this necessarily varies over so large an area, and probably it will be sufficient to state that they are as a whole fully equal to the similar ores obtained in Cornwall. From the poorest of these by the rudest processes, and without any of the most ordinary mechanical appliances which modern skill could introduce, from 30 to 40 per cent. of metal is obtained by the native workmen—from others, so high a per-centage as 60 per cent.

With the tin-stone in a few localities, Wolfram, as I have already pointed out in former papers, is to a small extent intermixed, but in the majority of the places I have mentioned, no injurious ingredient which cannot be readily got rid of occurs.

Why such valuable deposits of an ore, which requires in its reduction no expensive furnaces, no large constructions, and no great manipulative skill, should have hitherto been so entirely neglected by Europeans, I am

at a loss to conceive. Possibly the extent of these beds has not been known, although their occurrence in many places was made public by Colonel Tremenhoe many years since; still no attempts whatever have been made for their more extended or more systematic working. A grant of some 10,000 acres has been, I believe, made by the Government to two persons for "mining purposes," and having heard much of the richness of the Henzai District, where this grant is situated, and of the great works in operation there, I visited it with anticipation of seeing much, but was greatly disappointed to find that literally nothing was being done, or had been done, in the direction of mining. The good timber of the District, and the rich supplies of wood-oil, were being largely worked up, but the "mining purposes" for which the grant was made were represented by a single individual and his daughter washing at intervals for a little tin-stone which they sold to the proprietor.

In no other case that I am aware of has a grant for "mining purposes" of waste lands been made, nor until the system on which such grants are now made be modified is it desirable that such should be made.

I have not entered into any calculations to show the cost of obtaining this ore, of smelting, of export, &c., or of the profit to be derived therefrom. Such calculations could, in my case, be only based on isolated facts and experiences, and I am confident, that they would never be so satisfactory as the simple consideration of the fact, that this ore is largely worked now, in the most desultory, and more unskilled manner possible, but that in all cases a *large profit* is derived from the occupation.

A most serious drawback to the opening up of this country exists in *the total absence of any roads*. Throughout the entire range of the Tenasserim Provinces, with the exception of the few roads immediately around the stations of Moulmein, Tavoy, and Mergui, not a single road has been made within the quarter of a century during which these Districts have been under British Rule. The few short roads which do exist are of Burmese construction, and when leading to a monastery or pagoda are frequently of excellent and permanent workmanship; but there are always short, proceed in every possible direction, and are in no way intended for, or designed to aid the traffic of the country. It is true that over a large portion of the Provinces the ordinary means of communication is by water, and that stretching, as the country does, in a narrow strip along the sea-board, the sea itself forms the great highway from North to South; but such a communication can scarcely be said to

be open during the monsoon, or for nearly one-half of the year, during which time few native boats will venture out ; while the internal communication is closed for a great portion of the year by the drying up of the creeks during the rainless months. Thus, during the season in which there is easy means of communication from without, there is none from within, and no continuous traffic of any kind could exist.

I pointed out the necessity of such roads being opened out, in reporting on some specimens from these Provinces in the year 1851, and a personal examination of the Districts referred to then has only more strongly impressed upon me the urgent want of them. In fact I do not see how any marked improvement in these Provinces can possibly be looked for, until some facilities of inter-communication be afforded to the inhabitants of the several Districts.

Another very serious difficulty in undertaking any mining works, or even in the making of roads, is the great want of labour, owing to the very scanty and sparse population of the Provinces. For "mining purposes" alone, I do not look upon this as a very important matter. An abundance of Chinese can be obtained for all such works at fair remunerative wages from the Straits and Singapore, and they prove as skilled and excellent workmen as any in the world. Indeed, it would require long continued instruction to make a Burman a good miner, while by employing the Chinese in such works the others would be left to their natural agricultural pursuits, to the cultivation of the country, and to thus providing supplies of the ordinary kind ; but for labour of an ordinary kind there is undoubtedly a great deficiency of supply.

I believe, from every enquiry I was able to make, that there would be no difficulty whatever in procuring from India, either from Bengal or Madras, thousands of labourers, who would be delighted to go to these Provinces, induced by the certainty of an enhanced rate of wages ; and such is the present pressing want of labour, and the consequently very high pay given, together with an increasing demand, that any numbers, which could be imported for several years to come, would have but a slight effect in lowering these wages.

Several hundred natives of India now come voluntarily every year, chiefly from Madras, but there are no sufficient regulations regarding their transit. They come crowded into native vessels, often barely seaworthy, often too in a very much larger number than there is room for, without proper supplies of food or water. They suffer much during the

passage, and are constantly cheated by the masters of the vessels in which they sail. For a passage across from Madras in this way the ordinary rates are from Rupees 10 to 12; and this expense and exposure, several hundreds, as I have said, annually incur voluntarily and willingly; but from Bengal, they can seldom get to Moulmein for nearly double that sum. The charge for a deck passage by the steamers is, I believe, Rupees 22, and excepting in the rapidity of the voyage, and the certainty of a fair supply of water, they are more uncomfortable on board the steamers than in native crafts. No preparation whatever is made for them, they are exposed to all weathers, and are not permitted to make such temporary expedients for their own protection as every native would resort to, but which could not be allowed as interfering with the arrangements of a large and well-disciplined ship. To a native labourer the sum I have mentioned is perfectly prohibitory, and so long as this continues the charge, none such can be expected to take advantage of the facilities which a regular periodical steam communication might be expected to offer.

That the natives are willing, and anxious to do so, in preference to the danger and delay of other modes of travelling, is obvious from the constant flow of deck passengers to and from Rangoon and Moulmein. Their number averages I believe more than a hundred each voyage, and I have on more occasions than one seen many who were most desirous of going refused, as a sufficient number were already on board. The sum demanded for this passage, although high, is still within their reach, and they gladly pay it in preference to running the risks of native conveyance.

The question of the easy and abundant importation of labour is one of the most vital importance to these Provinces. There is not now a population sufficient for the ordinary cultivation of the country, much less for the supply of any increase demand for new works. Tens of thousands of acres, nay of miles of country, which could readily be made most productive, are now lying waste—the abode of the wild beast that roam the forests, for miles together, I have walked through—unbroken jungle and coppice, now growing on lands which once were evidently well inhabited and fully cultivated. In the midst of the forest, you meet ruined temples now covered with rank vegetation. A mangoe tree, or a group of palms, point out the former abode of man, where the intense quiet of the solitude is now only broken by the snort of the tiger, or the

trumpeting of a startled elephant. Where cultivation was once found profitable, no doubt can be entertained that it would be so again. War and tyranny, with all their evil consequences, drove from their homes the former inhabitants, and the noble task of renewing the country is still before any one who will undertake it.

I have not in these remarks attempted to enter into any more minute account of the general geological structure of the country than was absolutely requisite to explain the position, &c., of the coal and other deposits. A careful comparison of the fossils procured will be necessary for this, which I have had no opportunity of accomplishing as yet, and maps will also be required, which involve care and time in their preparation.

(Signed) THOMAS OLDHAM.

No. 1671.

FORT WILLIAM,

PUBLIC WORKS DEPARTMENT,

PUBLIC.

The 14th September 1855.

OFFICE MEMO.

THE undersigned has the honor to return herewith to the Secretary to Government in the Foreign Department the Report from the Superintendent of the Geological Survey of the results of his examination of the coal deposits in the neighbourhood of Thayet-myo, forwarded with Extract from that Department, dated the 25th ultimo, with the view to its being published (together with such portion of the previous* correspondence as he may think advisable) as a "Selection from the Records of Government."

It is requested that the original papers sent herewith may be returned after selection has been made.

(Signed) W. E. BAKER, *Lieut.-Colonel,*
Secy. to the Govt. of India.

* Construction, 15th June 1855, Nos. 149 and 150.

Construction, 17th August 1855, Nos. 92 to 97.

Docket from Foreign Department, No. —, dated 25th August 1855, with one original Enclosure.

No. 2434.

To

C. BEADON, ESQUIRE,
Secy. to the Govt. of India,
Foreign Department.

SIR,

I BEG to report for the consideration and orders of the Hon'ble the President in Council, that the H. C. S. *Sesostris*, on her arrival here from Rangoon on the 14th instant, brought with her two bags of coal, which had been found on the bank of the Irrawaddy, within the British Territories, 9 miles from Thayet-myo, and not more, as I am informed, than 2 miles from the main stream of the river.

2. This coal (2 maunds 23 seers) was sent up by Mr. C. Berry, Chief Superintending Engineer at Rangoon, as a sample of 50 maunds that had been sent on board the H. C. S. *Bentinck* by Lieutenant Ardagh, Deputy Commissioner at Prome, and on trial in the furnaces of that vessel pronounced on favorably.

3. Immediately on its receipt, I requested the Chief Superintending Engineer at Kidderpore to make trial of it, and the result is shown in a letter from Mr. Jones, under date 19th instant. From this it will be seen, that the coal sent from Prome by Lieutenant Ardagh was tried in the furnace of a small engine used at Kidderpore, and that it has proved equal to Burdwan coal and less than 25 per cent. inferior to English. The coal from Pegu was tried against picked Burdwan and very good English coal.

4. The obtaining of a supply of coal from a mine 300 miles up the Irrawaddy, equal in quality to Burdwan, would be of most important advantage, even in a commercial point of view only, as it would enable the Government and other steamers to ply on the various branches of Irrawaddy below the mine at a greatly reduced cost.

5. Under all the circumstances of the case, I would most respectfully urge on the consideration of the Hon'ble the President in Council the expediency of impressing on the Commissioner of Pegu the desirableness of an immediate examination of the seam of coal that has been discovered in such an eligible position on the Irrawaddy, with a view to its being worked and the coal made available for the service of Government and the public at as early a date as possible.

6. Perhaps His Honor may consider the case of sufficient importance to despatch a practical miner with necessary tools and a few workmen from Calcutta.

I have, &c.,

(Signed) T. E. ROGERS,
Supdt. of Marine.

*Fort William ;
Marine Supt.'s Office,
The 21st April 1855. }*

No. 30.

To

J. SUTHERLAND, ESQUIRE,
Offg. Secy. to the Supdt. of Marine.

SIR,

IN compliance with the request of the Superintendent of Marine, I have the honor to state that I have tried, in the small steam boiler, driving the punching and drilling machines in the Dock-yard, a sample of coal sent by Mr. Berry, Chief Superintending Engineer of the Rangoon Naval Yard, against two other kinds of coal, and beg to forward herewith a detailed statement of the trial. From the result it would appear that the sample sent from Rangoon is about equal, or perhaps a little superior, to Raneegunge coal, as the difference of time in its favor is 3 minutes and the ashes left is 12 seers less than those from Raneegunge coal.

Enclosed I beg to return the letter which accompanied the coal from Mr. Berry.

I have, &c.,

(Signed) M. JONES,
Chief Supdg. Engr.

*Kidderpore Steam Foundry, }
The 19th April 1855. }*

*Statement of Trial of Coal sent from Rangoon Naval Yard, by the
Chief Superintending Engineer, against Raneegunge and English
Coal.*

<i>Mr. Berry's Coal.</i>		<i>Raneegunge Coal.</i>		<i>English Coal.</i>	
	B. M. S.		B. M. S.		B. M. S.
Quantity,	2 23	Quantity,	2 23	Quantity,	2 23
Commenced burning, @	10-20 A. M.	Commenced burning, @	9-53 A. M.	Commenced burning, @	10-20 A. M.
Consumed,	1-40 P. M.	Consumed,	1-10 P. M.	Consumed,	2-45 P. M.
	H. M.		H. M.		H. M.
Time of burning,	3 20	Time of burning, ..	3 17	Time of burning, ..	4 25
	H. M.		M. S.		H. M.
Ashes and Cinders left,	36 Seers.	Ashes and Cinders left,	1 8	Ashes scarcely any.	.

(Signed) M. JONES,
Chief Supdg. Engr.

No. 1473 of 1855.

FROM

J. W. DALRYMPLE, ESQUIRE,
Offg. Under-Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated Fort William, the 25th April 1855.

FOREIGN DEPARTMENT.

SIR,

I AM directed by the President in Council to forward to you for report the accompanying copy of a letter and of its enclosure from the Superintendent of Marine, dated 21st instant, No. 2434, regarding the coal that has been discovered on the banks of the Irrawaddy, and found on trial to be of a superior quality.

I have, &c.,

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

MINUTE BY THE HON'BLE J. A. DORIN.

Dated the 26th April 1855.

I HAVE just received from Mr. Piddington, the Curator of the Museum of Economic Geology, a specimen of coal brought up from Pegu, which he has analyzed, and pronounces equal to the best English steam coal.

It appears that this coal was found at Thayet-myo, within our newly-acquired Provinces, and in an easily accessible site close to the banks of the Irrawaddy.

This discovery is so valuable, that I think it should be followed up without delay, and measures taken to secure the advantages that must result from a supply of coal easily obtainable and suited to all purposes of maritime and railway steam use.

The Commissioner in Pegu should be called on to report on the discovery, the exact position and extent of the coal field ; to whom the land belongs ; and if, as is probable, to the Government, to take measures to prevent its alienation or misappropriation, pending further instructions from Government.

If this coal turns out to exist in abundance, and of the quality represented by Mr. Piddington, its discovery will be one of the most valuable acquisitions yet made in aid of material progress in India.

(Signed) J. DORIN.

No. 1486 OF 1855.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated Fort William, the 27th April 1855.

FOREIGN DEPARTMENT.

SIR,

IN continuation of my letter No. 1473, dated the 25th instant, I am directed to inform you, that a further Report of the excellent quality of the coal found near Thyet-myo, on the banks of the Irrawaddy, having reached the Government, the Hon'ble the President in Council authorizes you to take immediate measures for providing a sufficient supply for the wants of the Government steamers employed in the Province, and for preventing the alienation or misappropriation of any part of the coal field, pending further orders from the Government.

2. Professor Oldham has been consulted as to the best means of obtaining a thorough survey and examination of this coal field. In the

meanwhile you are requested to report what is already known about it, as to its position, extent, and the persons, if any, who hold or claim any proprietary interest in it, or in the soil under which it lies, and to state what steps you propose to take for carrying out the instructions conveyed in the preceding paragraph.

I have, &c.,

(Signed) CECIL BEADON,

Secy. to the Govt. of India.

No. 1487 OF 1855.

FROM

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India,

TO

CAPTAIN T. E. ROGERS, I. N.,

Superintendent of Marine.

Dated Fort William, the 27th April 1855.

FOREIGN DEPARTMENT.

SIR,

WITH reference to your letter No. 2434, dated the 21st instant, reporting the discovery of coal on the banks of the Irrawaddy, near Thayet-myo, I am directed by the Hon'ble the President in Council to forward, for your information, copy of two letters addressed to the Commissioner of Pegu, and to request that you will direct the Officers of the Marine Department in Pegu to co-operate with the local authorities in making the produce of this coal field available, as soon and as largely as possible for the use of the Government steamers in the Province.

I have, &c.,

(Signed) CECIL BEADON,

Secy. to the Govt. of India.

No. 1488.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

T. OLDHAM, ESQUIRE,
&c. &c. &c.

Dated Fort William, the 17th April 1855.

FOREIGN DEPARTMENT.

SIR,

WITH reference to the correspondence noted in the margin,

From Superintendent of Marine, dated 21st
April, No. 2434.

To Commissioner of Pegu, dated 27th April
No. 1486.

To Superintendent of Marine, dated 27th
April, No. 1487.

of which a copy is enclosed, I am
directed to request that you will
state for the information of the
Hon'ble the President in Council
what steps you think had best

be taken for obtaining a thorough survey and examination of the coal
field recently discovered on the banks of the Irrawaddy in the Northern
part of the Province.

I have the honor to be, &c.,

(Signed) CECIL BEADON,
Secy. to the Govt. of India.

GOVERNMENT No. 52 OF 1855.

No. 10, GENERAL.

FROM

MAJOR A. P. PHAYRE,
Commr. of Pegu and Agent to the Gov. Gen.,

TO

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,
Offg. in the Foreign Department,
Fort William.

Dated Yay-ghen, in Tharrawaddy District,
The 5th May 1855.

SIR,

I HAVE much satisfaction in forwarding, for the information of
the Hon'ble the President of the
Council of India in Council copies
of letters as noted in the margin,

From the Deputy Commissioner of Promé
to the Commissioner of Pegu, No. 184, dated
2nd May 1855.

From the Deputy Commissioner, Prome, to Captain White, Assistant Commissioner, Thayet-myo, No. 113, dated 19th March 1855.

From Captain J. S. D. White, Assistant Commissioner, Thayet-myo, to the Deputy Commissioner, Prome, No. 187, dated 29th April 1855, with copy of Enclosure marked A.

White, the Assistant Commissioner stationed there, and the coal has been very favorably reported on by the Engineer of the H. C. S. *Mahanuddy*, copy of whose Report is annexed.

2. Captain White has obtained the assistance of five experienced miners from Her Majesty's 29th Regiment. These men are now engaged in running a gallery through the hill in which the coal is situated, with the view of striking on the spot where it is believed two seams unite into one.

3. Captain White promises to report hereafter the line by which he proposes to convey the coal by tram-way to the river, so as to be available for steamers. When this is received, I will forward the same for the information of the Hon'ble the President of the Council of India in Council—in the meantime, I beg to solicit sanction to the advance of Rupees 500 on account of the expenses of the mining operations.

4. I would beg to suggest that if Professor Oldham, now I believe employed in the Tenasserim Provinces, can be spared to look at this seam of coal, it will be very desirable that he should do so.

I have the honor to be, &c.,

(Signed) A. P. PHAYRE,

Commr. of Pegu and Agent to the Gov. Gen.

GENERAL NO. 184.

To

MAJOR PHAYRE,

Commissioner of Pegu.

Dated Prome, the 2nd May 1855.

SIR,

I HAVE the honor to submit copy of a Report on the coal vein found below Thayet-myo, which I have just received from Captain White; also of a letter of mine to his address, desiring him, on my own responsibility, to incur an expenditure of Rupees 500 in working the mine, in addition to any money which the sale of the coal worked may

fetch. This I purpose adjusting by making the selling rates a little more than what it can be actually dug for, so as to allow of a small profit being realized.

I solicit your sanction to this advance.

I have the honor to be, &c.,

(Signed) R. D. ARDAGH,
Deputy Commissioner.

GENERAL NO. 113.

To

CAPTAIN J. S. D. WHITE,
Assistant Commissioner, Thayet-myo.

Dated Prome, the 19th March 1855.

SIR,

HAVING seen a Report of the Engineer of the Steamer *Mahanuddy* on the coal which you had tried by him, and which appears to be excellently adapted for steam purposes, I have the honor, with reference to your last communication on this subject, to authorize you, on my responsibility, laying out in advance a sum not exceeding in gross Rupees 500, in excavating, &c., the sum to be recovered by sales to the river steamers of the coal excavated.

The amount of fuelling required for the trip hence to Prome is about 4,000 billets (in wood) I understand, which costs Rupees 40 or thereabout.

In coal I believe some 2 tons (54 to 56 maunds) will suffice, you will therefore be able not only to wipe off the Rupees 500 now advanced, but also to amass a small fund for working purposes by charging for this coal in gross what is paid for by the river steamers for wood, that is, Rupees 40 for 2 tons, which will give about double the rates of cost of coal at Calcutta, where it sells for Rupees 0-6-0 per maund.

To carry on the operations on a more extensive scale, I shall make due application to the Commissioner on receiving your promised Report.

I would suggest that the temporary service of one or two steady men, who are practically acquainted with coal mines, be procured from the Commander of Her Majesty's 29th Regiment. They will be useful in directing operations.

I have, &c.,

(Signed) R. D. ARDAGH,
Deputy Commissioner.

No. 187, GENERAL.

FROM

CAPTAIN J. S. D. WHITE,
Assistant Commissioner,

To

CAPTAIN R. D. ARDAGH,
*Deputy Commissioner, Prome.**Thayet-myo, the 29th April 1855.*

SIR,

IN continuation of my several letters to your address on the subject of coal, I have now much satisfaction in informing you that a seam of that valuable mineral has been discovered, of such a quality, and so favorably situated, that I trust considerable facilities, in the way of fuel, will be afforded to steam navigation on the Irrawaddy.

In December last, being driven away from my researches on this subject in the neighbourhood of Knay-donk in Thayet-myo by the prevalence of fever, I directed the hills South of Thayet-myo to be examined, having every hope, from information received and the bearing of the shale beds, that ultimately coal would there be found. In this hope I have not been disappointed, *vide* accompanying document A. I beg further to add, that the opinion expressed by the Engineer of the H. C. S. *Mahanuddy* has been endorsed by several experienced Officers commanding vessels of the Irrawaddy Flotilla, whose written Reports however have not yet come to hand.

By the kindness of Brigadier Lane, C. B., and Lieut.-Colonel Smith, Her Majesty's 29th Regiment, I have been enabled to avail myself of the assistance of five practical miners, whose opinion of the coal I am happy to say is highly encouraging.

The Htoun-doung coal vein is situated in a low range of hills South of Thayet-myo, and about 2 miles from the river
 Position and bearing of the coal. bank at its nearest point. From the spot where the excavation is proceeding, a descent of 500 yards to the valley level has to be overcome, no difficulty of moment may however be apprehended to the formation of a tram-road.

From the North side of the vein an old cart-road runs to within 150
 Roads to the coal. yards of the spot. Not having been in use however for some time, some expenditure will be requisite to put it in order. From the South there is a tolerable cart-road, much frequented by lime-burners, to within 500 yards of the excavation, as

above stated. It is by this route, from my present experience, I am induced to believe the coal will have to be wharfed on the river bank, but this will depend upon, whether it is deemed advisable to establish a coal depôt at Thayet-myo, or Htoun-doung-yna, or at Pyt-tha-layn-yna, South of the Htoun-doung hills. I will briefly recount the respective advantages of these routes as far as I can at present form an opinion.

First,—The Southern route is some $1\frac{1}{2}$ miles nearer to the river bank than the other, and apparently a tram-road could be constructed at comparatively a trifling cost. From Pyt-tha-layn-yna the coal could be shipped on lighters, either for transmission to Thayet-myo or the stations down the river, and I am inclined to believe that coal could be conveyed cheaper by water from Pyt-tha-layn-yna to Thayet-myo than *via* the Northern route. The disadvantage of the Southern route is that, for some distance down, the river steamers cannot approach the bank with safety.

Secondly,—The Northern route. By this to connect the coal mine to Thayet-myo, $6\frac{1}{2}$ miles of tram-road would have to be constructed: the first $2\frac{1}{2}$ miles would require a liberal expenditure. For constructing and maintaining, an expenditure considerably greater than the other route, when once the coal arrives at Thayet-myo, a material advantage is obtained, *viz.*, the steamers can coal off an excellent ghaut, whilst their flats are unloading, thus saving time. In Htoun-doung-yna I see no advantages for a coal depôt. True, if the coal is collected at Pyt-tha-layn-yna, thence sent up by water, some expence in transit will be saved, but the steamers would have to coal off a somewhat inconvenient wharf, lose time whilst they were coaling, and consume fuel in the way to and from Thayet-myo to the depôt.

If the coal were brought by the land route to the Htoun-doung, I beg to observe, the most troublesome and expensive portion of the tram-road would have to be constructed, and the objections of loss of time, consumption of fuel, &c., would not be removed.

Taking the above into consideration, I am at present of opinion, that the best route of conveying the coal is by train to Pyt-tha-layn-yna, and from thence by water to Thayet-myo. On this subject it would be premature to offer a decided opinion.

I have hitherto, in spite of any proper tools and the drawbacks attending the employment of idle and ignorant labourers, found no difficulty in daily excavating a tolerable supply, and I am assured by Corporal Adams, of Her Majesty's

Facilities for working.

29th Regiment, and his companions, that when they are put in possession of even a small supply of proper instruments, and the horizontal gallery at which we are at work is completed, no difficulty in working the coal will be experienced, and that a large supply will daily be available.* On receiving a list of mining tools from Corporal Adams, it shall be forwarded for consideration. Supervision and labour estimates, with regard to these points, shall shortly be forwarded, together with a sketch map of the places in the neighbourhood of the mine and a rough statement of the probable expenditure required by the trains. Timber is abundant on the spot. I have every confidence that shortly coal will be supplied at Thayet-myo at Rupees 13 a ton, and that with the aid solely of the very inefficient means at my command.

I had hoped ere this that the Commissioner would have been in possession of a very much more satisfactory Report than the mere outline I now have the honor to submit, and request you will point out that other duties demanding my presence at a distance from Thayet-myo have prevented my obtaining data on which to furnish a more elaborate statement. Knowing the interest Major Phayre takes in the subject of coal, I have deemed it advisable to submit, without further delay, this bare announcement of its discovery.

The effects of my late exposure not having yet passed away, I have gladly availed myself of the proffered services of Lieutenant Ashe, of the Artillery, in drawing up the details, which I will submit with the least possible delay.

In a country like this, and with the very slender knowledge I possess on the subject, I trust the Commissioner will view with forbearance my zealous, though ill-directed, endeavours to develop the resources of that portion of the Province, in which I have the honor to serve.

I have the honor to be, &c.,

(Signed) J. S. D. WHITE, *Captain,*
Assistant Commissioner.

NO. 29 A.

To

CAPTAIN WHITE,

Assistant Commissioner, Thayet-myo.

SIR,

I have the honor to forward the enclosed Memorandum relative to the coal received from you, and to state that having been pre-

* 50 tons per diem.

sent during the time it was under trial, I concur in the answers and opinion given by my Chief Engineer.

I have, &c.,
(Signed) J. M. EALES,
Commanding.

Prome ;
H. C. S. Mahanuddy, }
The 15th March 1855.

-
- Q. 1st.—Does the coal leave much ashes after combustion ?
A. Very little and that of a good color.
Q. 2nd.—Does it emit much smoke and gas during combustion ?
A. Very little, but emits a large quantity of gas.
Q. 3rd.—Does it coke much during combustion ?
A. A good deal, but does not clinker much.
Q. 4th.—Does it take fire easily ?
A. It does.
Q. 5th.—Does it throw out a great amount of heat ?
A. A large amount.
Q. 6th.—Does it readily crumble into dust ? and any other remarks
on the subject will be prized.
A. It does.

I consider the sample equal to Cherra-poonjee coal ; it ignites readily, throws out a large amount of heat, does not clinker much, and leaves a very small quality of ashes. I am of opinion that it will answer admirably for steaming purposes. During the two hours' trial I found the stokers could keep up steam with the greatest ease.

Prome ;
Steamer Mahanuddy, }
The 15th March 1855.

(Signed) C. BOWEN,
Chief Engineer.

No. 1867.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated Fort William, the 30th May 1855.

FOREIGN DEPARTMENT.

SIR,

I HAVE the honor to acknowledge the receipt of your letter, dated the 5th instant, No. 52, forwarding copies of letters relative to the discovery by Captain White, Assistant Commissioner, of a seam of coal in a hill about 6 miles from the station of Thayet-myo.

2. In reply I am directed to acquaint you, that the Hon'ble the President in Council thinks the discovery of this coal, so far as it goes, very promising, and that every encouragement should be given to further prosecution of the search for it. The advance of Rupees 500, solicited on account of the expenses of the mining operations, is accordingly sanctioned. Care should be taken that no portion of the coal field is alienated or misappropriated, as already directed in my letter to your address, dated the 27th ultimo, No. 1486.

3. Mr. Oldham has been requested to examine and report upon the coal field, and measures have been taken for sending down by the next steamer a suitable supply of mining tools.

4. His Honor in Council will expect from you a further Report of your proceedings as soon as convenient.

I have, &c.,

(Signed) CECIL BEADON,
Secy. to the Govt. of India.

Nos. 1868 AND 1869.

ORDERED that Extract paras. 1 and 3 of the above letter be sent to the Military Department, for the issue of the requisite orders to the authorities in the Arsenal, and paras. 1 and 2 to the Financial Department for information.

No. 1870.

ORDERED also that a copy of Major Phayre's letter and enclosures and of this reply be sent to the Department of Public Works, in order that it may be considered whether it is expedient to send an Engineer Officer to Thayet-myo to survey the road.

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

No. 1871.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

T. OLDHAM, ESQUIRE,
Supdt. of the Geological Survey.

Dated Fort William, the 30th May 1855.

FOREIGN DEPARTMENT.

SIR,

IN continuation of my letter dated the 27th ultimo, No. 1488, I am directed by the Hon'ble the President in Council to forward to you a copy of a further correspondence respecting the coal field recently discovered on the banks of the Irrawaddy, and to request that you will proceed at your early convenience to Prome for the purpose of examining and reporting upon it for the information of Government.

From Commissioner of Pegu, No. 52, dated 5th May 1855.
To Ditto, No. 1867, dated 30th May 1855.

I have, &c.,

(Signed) CECIL BEADON,
Secy. to the Govt. of India.

Fort William, }
The 30th May 1855. }

No. 1872.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

G. F. EDMONSTONE, ESQUIRE,
Secy. to the Govt. of India,
With the Governor General.

Dated Fort William, the 30th May 1855.

FOREIGN DEPARTMENT.

SIR,

I AM directed by the Hon'ble the President in Council to

From Superintendent of Marine, No. 2434, dated 21st April 1855.

To Commissioner of Pegu, No. 1473, dated 25th April 1855.

Minute by the Hon'ble J. A. Dorin, dated 26th April 1855.

To Commissioner of Pegu, No. 1486, dated 27th April 1855.

To Superintendent of Marine, No. 1487, dated 27th April 1855.

To T. Oldham, Esq., No. 1488, dated 27th April 1855.

From Commissioner of Pegu, No. 52, dated 5th May 1855.

To Ditto, No. 1867, dated 30th May 1855.

To T. Oldham, Esq., No. 1871, dated 30th May 1855.

forward, for the information of the Most Noble the Governor General, a copy of the correspondence noted in the margin, on the subject of the discovery of a seam of coal on

the banks of the Irrawaddy.

I have, &c.,

(Signed) CECIL BEADON,

Secy. to the Govt. of India.

Fort William,
The 30th May 1855. }

No. 621.

FROM

LIEUT.-COLONEL W. E. BAKER,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated the 15th June 1855.

PUBLIC WORKS DEPARTMENT,

PUBLIC.

SIR,

WITH reference to your letter No. 52, dated the 5th ultimo, to the address of the Officiating Secretary to Government in the

Foreign Department, and its enclosures, relative to the discovery of a seam of coal in a hill not far from the station of Thayet-myo, I am directed to state, that it appears to the President in Council very desirable that a careful survey should be made of that locality as soon as possible, with a view of designing the best line of road or tram-way to the most inconvenient ghaut on the river, provided that further research shall justify the expectations now entertained, that coal can be procured in sufficient quantity to warrant the cost of such a work. I am accordingly to request that the services of Mr. Login, lately appointed to Pegu, may if possible be made available for this duty. In the event of your reporting that Mr. Login is already occupied with other and more important duty, endeavours will be made to depute a competent surveyor from Calcutta.

I have the honor to be, &c.,

(Signed) W. E. BAKER, *Lieut.-Colonel,*
Secy. to the Govt. of India.

No. 24 A.

FROM

THE SUPDT. OF THE GEOLOGICAL SURVEY,

TO

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India.

Dated the 4th June 1855.

SIR,

I HAVE the honor to acknowledge the receipt of your letter, No. 1488, dated 27th April, and giving cover to correspondence relative to the discovery and trial of some coal from the neighbourhood of Thayet-myo on the Western bank of the Irrawaddy River, and requesting me to report what steps were desirable, with a view to a careful examination and survey of the locality.

Having on the day previous to the receipt of your letter returned from the Southern Districts of the Tenasserim Provinces, after a careful examination of all the known coal-yielding localities there, it appeared to me to be most desirable to visit the Thayet-myo locality at once ; but as

the monsoon had already set in with great force at Moulmein, I immediately placed myself in communication with Major Phayre, Commissioner of Pegu, and after a consultation with him, I have made the following arrangements in anticipation of the sanction of the Government of India, and I trust the plan will meet the approbation of the Hon'ble the President in Council.

Mr. Wm. Theobald, one of my Assistants, will proceed by the earliest opportunity (in a few days) to the district in which the coal has been found, and make himself thoroughly acquainted with the details, visiting all the localities; and I shall myself subsequently join Mr. Theobald there and re-examine the principal points. I shall take advantage of the interval to proceed to Calcutta, in order to have some instruments, which have been injured during the very jungly work of the past season, repaired, and to obtain some others which will be required during the visit of Major Phayre to Ummeerapoorra (to whose party the Hon'ble the President in Council has done me the honor to attach me,) arrangements which I should not have been able to perfect previously to the time named for Major Phayre's departure in any other way. I confidently hope, therefore, to be able to lay before the Government of India a Report on the District of Thayet-myo before the close of the ensuing month. The rainy weather will unquestionably interfere somewhat with our labours, but as I am led to hope, not to any material extent.

Should these arrangements meet the sanction of the Hon'ble the President in Council, I have to request that the authority granted to the Commissioner of Tenasserim and Martaban Provinces, to make advances to me for the current expenses of the Geological Survey, to the extent of Rupees 1,500 per month, may be extended to the Commissioner of Pegu, such sums being subsequently adjusted in the same manner as hitherto.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,

Supdt. of the Geological Survey.

Rangoon,
The 4th June 1855. }

No. 2339.

FROM

J. W. DALRYMPLE, ESQUIRE,
Offg. Under-Secy. to the Govt. of India,

TO

T. OLDHAM, ESQUIRE,
Supdt. of the Geological Survey.

Dated Fort William, the 29th June 1855.

FOREIGN DEPARTMENT.

SIR,

IN reply to your letter, dated 4th instant, No. 24 A., I have the honor to convey the sanction of the Hon'ble the President in Council to the arrangements mentioned therein, with a view to a careful examination and survey of the coal field recently discovered on the banks of the Irrawaddy, as also to your coming to Calcutta, in order to have some instruments repaired and to obtain others.

2. I am at the same time to acquaint you, that the necessary orders will be issued from the Financial Department, authorizing the Commissioner of Pegu to permit your drawing, to the extent of Rupees 1,500 per mensem, for the current expenses of the surveying party, the amount to be adjusted in the same manner as hitherto.

I have the honor to be, &c.,

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

No. 2340.

ORDERED that a copy of the above correspondence be sent to the Financial Department, for the issue of the necessary orders, in continuation of orders dated 22nd December last, No. 5381.

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

GOVERNMENT NO. 64 OF 1855.

NO. 13, GENERAL.

FROM

MAJOR A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.,

TO

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India,

Offg. in the Foreign Department.

Dated Rangoon, the 29th May 1855.

SIR,

WITH reference to your letter to my address, No. 1486, dated the 27th ultimo, and in continuation of my letter, No. 52-10 dated 5th May 1855, relative to the coal discovered near Thayet-myo, I have now the honor to submit, for the information of the Hon'ble the President of the Council of India in Council, copies of letters as noted in the margin, containing further Reports upon that subject.

2. Captain White describes his proceedings on the first discovery of the coal, and the progress of the miners in working the gallery through the hill to strike the vein of coal below the surface. He also explains how he proposes to convey the coal by tram-way to join an existing road leading to the village of Py-tha-lying* on the Irrawaddy, a distance of about 2 miles from the coal mine. Eventually the tram-way would be constructed the whole way to Py-tha-lying, where there is convenient anchorage for steamers to receive it. A wharf should also be built there for facilitating the loading of boats and steamers. The expense of the tram-way, as far as the point D., including purchase of carts and bullocks, sheds for the coal and miners' houses, &c., is put down at Rupees 3,945. As Captain White will hardly be able to undertake the details of this work himself, I beg to recommend that some person accustomed to such works may be sent for the purpose of superintending the laying down of the tram-way with artificers for the construction of the wains, &c.—in the meantime

* Vide Map Z.

I beg to solicit sanction for the purchase of bullocks and carts and the hiring of drivers as recommended by Captain White.

3. With reference to the mining establishment recommended by Captain White, there are now four European miners kindly allowed to work by Colonel Smith, commanding Her Majesty's 29th Regiment. I would beg to suggest that these men be continued on for the present, until the Report of the survey of this coal field shall have been rendered, when the full establishment required can be safely estimated. But a few native miners from Bengal, if sent at once with their tools, would be of great service. Captain White recommends the sum of Rupees 50 a month for the European miners. I am unable to give an opinion as to whether this sum is a fair amount of wages for English miners in India if in regular employ, but the four men from Her Majesty's 29th Regiment, hitherto employed, have worked so well under all the disadvantages of bad tools, heat of weather, and little or no native assistance, that I beg they may be allowed each that sum from the period they first commenced work and until some permanent arrangement of the establishment be made.

4. Captain White has already indented for tools for the workmen now employed, so I need request nothing on that head, but I trust that the Hon'ble the President of the Council of India in Council will permit me to apply to the Major General Commanding the Pegu Division for the services of about twelve sappers, as recommended by Captain White for the construction of the inclined way.

5. I beg to bring to the notice of the Supreme Government the very creditable exertions of Captain White in the discovery of this coal, and in designing a plan for making it available. Care has been taken to carry out the orders received to prevent the alienation or misappropriation of any part of the coal field. The land under which it is found is unoccupied waste, and has no proprietor as I am at present informed. I have directed a special Report to be made on this point, which, when received, I shall have the honor to address you hereafter.

I have the honor to be, &c.,

(Signed) A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.

GENERAL No. 199.

To

CAPTAIN ARDAGH,

*Deputy Commissioner, Prome.**Thayet-myo, the 22nd May 1855.*

SIR,

WITH reference to my general letters, Nos. 187 of the 29th ultimo, and 194 of the 10th instant, I now have the honor to submit for Major Phayré's consideration a summary of the information I have up to date been able to glean on the subject of the Thayet-myo coal. There are points on which I touch with great diffidence, as they more properly belong to the department of the practical engineer and require time to fairly elucidate.

On first discovering indications of coal, I directed a simple trench to be excavated in the direction the coal vein appeared to run (N. E. and by N. S. W. and by S.) The symptoms at first were discouraging, but we persevered, and at a depth of 12 feet struck the true coal. From this trench all the sample fuel hitherto submitted has been taken up.

It was apparent however that this method of working the coal was out of the question, for not only would the mere fall of rain have filled our open trench, but just at the spot where the coal cropped out, the courses of two hill torrents poured their united drainage of the heights. Consequently, with the assistance of five miners from Her Majesty's 29th Regiment, I re-commenced operations round the spur of the hill, by driving a gallery to meet the coal vein at a right angle. In spite of the obstacles offered by the extreme hardness of the rock, the work has progressed most favorably,* and I am happy to say without the slightest accident.

The tools the miners have had to work with are very indifferent and scarcely adapted to the purpose, but by the aid of small blasting charges, all difficulties have been overcome and we are now within two yards of the coal vein—the rock is passed, and the fire-clay reached—in two more days the vein will be laid bare.

Having reached the coal, it has to be considered how, when excavated, the fuel is to be conveyed to the river bank.

I now beg to submit a sketch of the hills in which the coal is found (Z) and the roads connecting it with the river bank.

* The gallery is now 50 yards in length.

I originally proposed making a cutting for a road on the hill-side just above the pathway (C. C. C.,*) but on further inspection found it would be very expensive and laborious, besides being liable to be cut away by the rush of water. I therefore determined to convey the fuel to the road-way by the path leading from the gallery A. to the miner's house B. Between these spots a rugged ravine intervenes and the hill-side leading to the house is somewhat steep. I propose overcoming these difficulties by constructing a stout wooden bridge across the ravine from the materials on the spot.

From the bridge an incline of 240 yards carries us to the crest of the small hill on which the house B. is situated.

On this incline I propose laying down wooden tram-ways on which the coal veins may run. A wooden drum, with a diameter of 6 feet, will be constructed on the hill crest. On this a stout hawser is to be worked by bullocks.† By this means a cart, with half a ton of coal, can be dragged up without difficulty each trip.

From B. a road (marked in the plan thus ——' / "——" / "——" /) can be constructed without much expense or difficulty, to join the excellent natural road at the hill foot.

It would be desirable to have a tram-way laid down the whole way on this road to Py-tha-layn, but I have not yet had time to devote to the preparing an estimate of its probable cost. It would however be comparatively trifling, as the road is quite level, and abundance of wood adapted for the purpose is on the spot. On a tram-way the bullocks could drag twice as much as on the common road.

The breadth of the coal vein is put down at 4 feet. The following rough estimates are made on the basis, that six tons of coal per diem would be excavated. Hereafter I opine the amount might be very

* This is a mere passage in the bed of the torrent covered with large boulders.

† If they could be spared, two elephants would be preferable, or one of the animals with the assistance of the drum.

largely increased. Circumstances and experience will doubtless modify the items.

Dr.

<i>Probable Primary Outlay.</i>	Rs. As. P.	Rs. As. P.	
Tools for working the coal. Having no data on which to go, I cannot venture as to their probable cost,...	0 0 0		
Constructing a bridge to connect the coal gallery with the hill B.,.....	180 0 0		
Cutting an incline from the bridge to the crest of the hill B.,*	250 0 0		* This could be done cheaper and better if the services of a few sappers could be spared.
Laying down a tram-way on the above incline,	230 0 0		
Constructing a wooden drum, on which the hawser is to work,	100 0 0		
To four wains to work on the incline, at 200 each,	800 0 0		
To constructing a road-way from B. to D.,	600 0 0		
A slight extra expense would be required on the road to Py-tha-layn, say,	300 0 0		
To the purchase of 10 carts and 10 pair of bullocks for conveying the coal to the river bank, at Rupees 50 each,	500 0 0		
To the purchase of 3 pair of bullocks for working the drum, at Rupees 45 each pair,.....	135 0 0		
To constructing houses for the miners and coolies employed,	500 0 0		
Sheds for bullocks,.....	150 0 0		
Sheds for the coal at Py-tha-layn, ..	300 0 0	4045 0 0	
<i>Probable Monthly Expenditure.</i>			
To one Head European Miner,*	80 0 0		* This sum would have to be increased if the man had no other emoluments save his wages.
„ four European miners, at Rupees 50 each,	200 0 0		
„ ten coolies, at Rupees 7 each,	70 0 0		
„ eleven bullock-drivers, at Rupees 8 each,	88 0 0		
„ a Superintendent of coal stores and account keeper,.....	150 0 0		
„ feeding 11 pair of bullocks, at Rupees 4 per pair,	44 0 0		
„ wear and tear and repairs,†.....	100 0 0	732 0 0	† This item experience must determine.
		4777 0 0	

Cr.

	Rs. As. P.	Rs. As. P.
Monthly value of fuel,	0 0 0	
<i>Excavated.</i>		
To six tons of coal per diem, 28 maunds to the ton = 168 maunds, at 10 annas per maund = monthly for 25 working days in the month,	2625 0 0

I beg the Commissioner will take into consideration the circumstances under which the above estimates are submitted and the difficulties I have had to encounter (from my own inexperience in such matters) in framing them.

As some apology for the delay in forwarding these details, I would beg to plead the other arduous duties that have lately occupied me, and remove me from this neighbourhood.

Inaccuracies will doubtless appear in these Reports, and my crude details I fear will afford but a slender guide to those in authority. To any theoretical knowledge or scientific arrangement of the subject I do not pretend, but simply aspire to be considered the pioneer in a discovery which in the hands of others better fitted for the task, I earnestly trust may prove of some benefit to this Province.

I have the honor to be, &c.,

(Signed) J. S. D. WHITE, *Captain,*
Assistant Commissioner.

GENERAL NO. 194.

To

CAPTAIN ARDAGH,

Deputy Commissioner, Prome.

Thayet-myo, the 18th May 1855.

SIR,

I HAVE the pleasure to acknowledge the receipt of your general letter, No. 199, enclosing a demi-official communication from Mr. Berry, Superintendent of the Dock-yard at Rangoon, on the subject of the coal found near Thayet-myo.

I have twenty bags of coal ready for transmission by the next steamer ; this fuel has been taken promiscuously from a heap now on the river bank.

In reply to the queries of the Commissioner I have the honor to state—

First,—Corporal Adams and the other European miners assure me the two veins united will be between 6 and 9 feet broad, but with all

due deference to their practical experience, I deem it advisable not to rate the vein at a greater breadth than 4 feet—at the same time I have little doubt that Corporal Adams is right in expecting to find other veins close to the one on which we are at work.

Secondly,—I beg your attention to the accompanying rough sketch A., by which you will perceive that the coal cropped out on a spot where two water-sheds unite. On this spot I commenced experimental operations by simply digging an open trench, but it will be apparent that when rain falls this trench will be entirely filled with water. It has therefore been necessary to commence a shaft round the shoulder of the hill, as shown at A. B. of the sketch. This shaft will be about 40 yards long. Our progress, however, is very operose from the extreme hardness of the sand-stone through which we have to work. Whilst driving this shaft we have come upon iron ore of superior quality, but in small quantity. The miners are confident that it will be found to a considerable amount. I trust this may be the case, but hardly dare hope for so fortunate a result.

Thirdly,—I beg to attach a List of Tools required (B); many of these I hope shortly to obtain; Brigadier Lane, C. B., Commanding at Thayet-myo, having, with great consideration, forwarded an indent for me under his own signature to the Arsenal at Rangoon or Fort William.

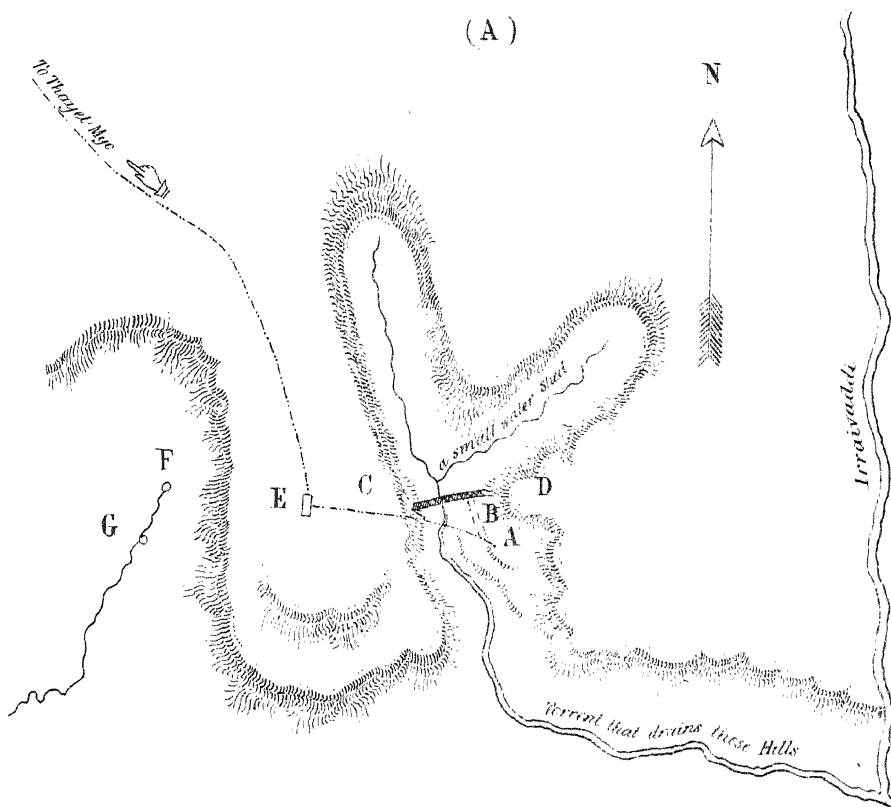
I have further the pleasure to forward a Sketch Map (C.) of the hills
 Z. in which the coal is found, and the roads leading
 (Sd.) A. P. P. from Thayet-myo and Py-tha-layn to the mine. I
 have to thank Lieutenant Oakes, of the Madras Engineers, for this Map.

I now, Sir, beg that you will solicit the Commissioner to grant me a further advance for carrying on these mining operations; the sum sanctioned by you and the Commissioner, has been expended, but deeming the working of this coal of such great importance, I have taken upon myself to continue the operations. When once we strike the coal vein, not only will it pay its own expenses, but very speedily repay any advance made on its account.

Up to date we have only succeeded in inducing four Burmans to work in the shaft; the generality of them view with considerable suspicion the progress of a work, the purport of which they cannot comprehend. I am happy to add, however, that labourers are gradually getting less afraid of approaching the mine.

I have, &c.,

(Signed) J. S. D. WHITE, *Captain,*
Assistant Commissioner.



A B Shaft now being driven into the hill to meet the Coal vein

C D Coal vein first discovered & worked slightly as an Experiment

E Small Bungalow for Miners

F Mineral Spring

G Spring slightly impregnated with iron

(S^d)

J S D White Captⁿ

List of Articles required for the Coal Mine near Thayet-myo.

One complete set of Blasting Tools.

12 Still Wedges, of 2 lbs. weight each.

12 Iron Wedges, of 4 lbs. weight each.

12 Straight Picks, 2 feet long, 3 lbs. weight each.

12 Straight Picks, 20 inches long, 3 lbs. weight each.

12 Stone Picks, 6 lbs. weight each and 20 inches long, curved 4 inches.

2 Hatchets, 7 lbs. weight, 7 inches broad and 9 inches deep in the blade.

(N. B.—For hewing timber for the gallery frames.)

3 Sledge Hammers, 14 lbs. weight, 8 inches long, flat ends.

3 Ditto, 9 lbs. weight, 1 foot long.

2 Safety Lamps.

12 Shovels.

(Signed) J. S. D. WHITE,

Assistant Commissioner.

No. 2366.

FROM

C. BEADON, ESQUIRE,

Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,

Commissioner of Pegu.

Dated Fort William, the 3rd July 1855.

FOREIGN DEPARTMENT.

SIR,

I AM directed to acknowledge the receipt of your despatch, dated the 29th May, No. 64, submitting two letters from Captain White, respecting the coal field lately discovered in the vicinity of Thayet-myo, and recommending various measures for working the same.

2. In reply I have to acquaint you, that the Hon'ble the President in Council sanctions the outlay of Rupees 3,945 for the tram-way pro-

posed to be constructed to facilitate the transport of the coal for the purchase of carts and bullocks and for the erection of sheds and other buildings. Captain White may also be instructed to engage the necessary drivers and other workmen at once.

3. Application has already been made to the Department of Public Works for the services of an Engineer Officer if available.

4. For the present you are authorized to continue to employ the four men from Her Majesty's 29th Regiment as miners and to pay them the salaries proposed of Rupees 50 each, commencing from the date they were placed at your disposal. If the services of native miners can be procured, they will be engaged and sent down as early as possible.

5. The requisite tools have already been forwarded, and with regard to your application for twelve sappers, I am desired to say that the Major General Commanding the Pegu Division will be addressed on the subject through the Military Department.

6. Your future communications in all matters connected with the coal mine should be addressed to the Department of Public Works.

I have the honor to be, &c.,

(Signed) C. BEADON,

Secy. to the Govt. of India.

No. 2367.

Extract from the Proceedings of the Hon'ble the President of the Council of India in Council, in the Foreign Department, under date the 3rd July 1855.

READ a letter from the Commissioner of Pegu, No. 64, dated 29th May (para. 4,) requesting the services of twelve sappers to help in constructing a tram-way from the coal field discovered near Thayet-myo.

Ordered that the Military Department be requested to communicate with the Major General Commanding the Pegu Division on the subject of this application.

(True Extract)

(Signed) C. BEADON,

Secy. to the Govt. of India.

GOVERNMENT No. 121 of 1855.

FROM

MAJOR A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.,

TO

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India,

Offg. in the Foreign Department,

Fort William.

Dated Rangoon, the 4th July 1855.

No. 22, GENERAL.

SIR,

I HAVE the honor to acknowledge the receipt of your letter, No. 1486, of the 27th April last, and in reply beg to annex a copy of the correspondence noted in margin.

Deputy Commissioner,
Prome, to Commissioner
of Pegu, No. 273, 20th
June 1855.

Assistant Commissioner,
Thayet-myo, to Deputy
Commissioner, Prome,
No. 223, 14th June 1855.

2. Captain White, it will be seen, declares his inability to state the extent of the coal fields, and it appears that no proprietary right can exist in

the soil overlaying it.

I have the honor to be, &c.,

(Signed) A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.

Pegu Commissioner's Office ;
Rangoon,
The 4th July 1855. }

NO. 273, GENERAL.

TO

MAJOR A. P. PHAYRE,

Commissioner of Pegu.

SIR,

I HAVE the honor to annex copy of letter No. 223, General, from Captain White, Assistant Commissioner, Thayet-myo, on the subject of the coal bed at Thayet, in reply to your letter No. 110 of the 22nd ultimo.

I have, &c.,

(Signed) R. D. ARDAGH,

Deputy Commissioner.

Prome,
The 20th June 1855. }

To

CAPTAIN ARDAGH,

Deputy Commissioner, Prome.

Thayet-myo, the 14th June 1855.

No. 223, GENERAL.

SIR,

No. 1486, from the Secretary to Government to Major A. P. Phayre, Commissioner and Governor General's Agent in Pegu.

No. 110, from Major A. P. Phayre to Captain R. D. Ardagh, Deputy Commissioner, Prome.

I HAVE the honor to acknowledge the receipt of your general letter, No. 234, of the 2nd instant, forwarding copies of documents noted in the margin.

With reference to the letter from the Secretary to the Government of India to Major Phayre, Commissioner and Governor General's Agent in Pegu, calling for further information regarding the Thayet-myo coal, I have the honor to state that perhaps my Reports will ere this have supplied the information required, with the exception of as to the extent of the coal bed and any proprietary right that may exist in the soil overlaying the coal.

I am quite unable to state to what extent the coal may be found. This I opine would require a carefully executed survey by persons deeply conversant with the subject. The lands at the coal mine, and for some distance in its neighbourhood, have never been used for any save Toungyah cultivation; and if I am not mistaken, such temporary occupation—the Toungyahs being changed every year—bestows no right to a permanent on the soil—in fact no such pretension has been put forward.

I have, &c.,

(Signed) S. D. WHITE, *Captain,*
Assistant Commissioner.

GOVERNMENT No. 67 OF 1855.

FROM

MAJOR A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.

TO

LIEUT.-COLONEL W. E. BAKER,

Secy. to the Govt. of India,

Public Works Department,

Fort William.

Dated Rangoon, the 11th July 1855.

No. 99, D. P. W.

SIR,

I HAVE the honor to acknowledge the receipt of your letter No. 621, dated 15th ultimo, and in reply to state, that Mr. Login had, at my request, commenced to take the levels of the whole cantonment, town, and suburbs of Rangoon. He has accomplished a good deal of this important work, but from the constant rain at this season, he considers what remains may be more advantageously carried on when the weather has moderated. Mr. Login is also desirous of seeing the Irrawaddy River when in high flood, and I have therefore directed him to proceed at once up the river to the coal field near Thayet-myo, and there make a careful survey of the locality as directed in your letter under reply.

I have the honor to be, &c.,

(Signed) A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.

Pegu Commissioner's Office ;
Rangoon,
The 11th July 1855. }

No. 1276.

FROM

LIEUT.-COLONEL W. E. BAKER,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated the 17th August 1855.

PUBLIC WORKS DEPARTMENT.

PUBLIC.

SIR,

IN reply to your letter Nos. 67-99, dated the 11th ultimo, I am directed to state, that the Hon'ble the President in Council approves of your having directed Mr. Login to proceed to the coal field near Thayet-myo with the view of making a careful survey of that locality.

I have the honor to be, &c.,

(Signed) W. E. BAKER, *Lieut.-Colonel,*
Secy. to the Govt. of India.

Fort William, }
The 17th August 1855. }

No. 27.

FROM

THE SUPDT. OF GEOLOGICAL SURVEY,

TO

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

Dated the 4th August 1855.

SIR,

I HAVE the honor to report, for the information of the Hon'ble the President in Council, that in accordance with arrangements previously sanctioned, immediately on my return to Rangoon, I proceeded to this Station, and commenced an examination of the coal deposits in this neighbourhood, which had been brought to light through the exertions of Captain White, Assistant Commissioner. This had been previously visited by Mr. Theobald, my assistant, and partially examined, and I have the honor to submit herewith the results of my research.

It is with great regret, that I have been compelled to advise the stoppage of any further work here, for although at first I was sanguine as to the result, and trusted that the persevering enquiries of Captain White would be fully rewarded, further examination has not confirmed these hopes. The cause of this I have endeavored to make clear in the accompanying Memorandum.

I have to express the obligations we are under for the friendly co-operation and assistance we have received from all the authorities here, both Civil and Military.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,

Superintendent of Geological Survey.

Thayet-myo, }
The 4th August 1855. }

MEMORANDUM ON THE COAL FOUND NEAR THAYET-MYO ON THE IRRAWADDY RIVER.

Position.—The Station of Thayet or Tharet-myo is situated on the right bank of the Irrawaddy River, in North latitude $19^{\circ} 21' 36''$, about 30 miles North of the large town of Prome and about 11 miles South of the boundary of the British Territories. The village and cantonments are pleasantly situated near the centre of an extensive and gently undulating plain, bounded on the East by the river bank, and the limits of which, to the North, are defined by the small range of hills, which are opposite to the Cantonment of Meeaday, and to the South by a second and very similar range which stretches from the Irrawaddy in a North-westerly direction for about 4 miles, between the villages of Pya-tha-ling on the South and Toung-doung on the North. It is in this latter range, and on the North-western slope of the hills, that the coal has been found. This range nowhere rises to a greater elevation than 800 feet and its average height is considerably less.

Geology.—The undulating plain about Thayet-myo is formed entirely of sand and gravel, similar to, and a continuation of, that which is seen well exposed in the banks of the Irrawaddy at the Station. This gravel is composed, principally, of much rolled and rounded pebbles of quartz, of many varieties of granites, hard siliceous slates, and nodules of ferruginous sands. In it are found numerous and occasionally very large

masses of silicified wood (chiefly, though not exclusively endogenous,) and though rarely of fossilized bones. It occurs in regular layers associated with sand, and occasionally with earthy shaly beds, dipping at low angles to the North and North-west, although for the most part loosely aggregated, and slightly coherent, the sands and gravel are occasionally found cemented into hard conglomerates and sand-stone, by the peroxide of iron, forming a dark-red ferruginous bed.

Passing over these for some three miles in a South-west direction from the Station of Thayet-myo, the road gradually rises over low spurs from the general range, which are composed of grey and greyish-blue shaly beds, with intercalated layer of hard calcareous sand-stones, often nodular in structure. The clayey beds themselves frequently become clunchy also. Of this series there is a thickness of about 400 feet. The beds dip at angles from 25° to 30° to N. 25° E. and N. 30° E., and are therefore quite unconformable to the overlying beds of gravel and sand, which appear to be of much more recent date.

Below these earthy beds are sandstones, soft, brownish and earthy, with very hard calcareo-siliceous layers, often containing well preserved fossils, and frequently one mass of comminuted fragments of shells. These have a thickness of about 150 feet.

Under these again come regularly deposited flaky beds of brownish earthy sand, with a few hard layers, exhibiting a repetition of the same conditions throughout their entire thickness, which is not less than 300 feet.

These rest upon lime-stone, which has a thickness of 70 feet in parts, but is not very regular. This, by its hardness and consequent prominence, form the summit of the ridge. It is of a light grey colour, hard and compact, full of minute fossils (*foraminifera*,) fragments of shells, corals, &c. Some of the beds are massive, others more flaky, and separated by thin earthy partings. The whole, as are also the beds of sand-stone, &c. above, is of marine origin.

This lime-stone is here largely used for the manufacture of lime, being burned in kilns in the neighbourhood of the hills or on the river bank, and thence exported. The mode of obtaining the stone is simple enough, but effective. I have mentioned that it occurs forming the summit of the ridge, and from this the loosened blocks are shot down the steep slopes of the hill-side, soon forming a clear course for themselves, and are collected at the base and carted away. Several of these deep

scarfings, along which the lime-stone is thus delivered, can be seen on the hill face from the Station of Thayet-myo.

Under the lime-stone again occur soft earthy beds of brownish clunchy clay in regular layers, then sandstones, loose and pebbly, of a reddish tint, then clunchy clay of grey and blue grey colour, with harder and more sandy layers, and a few thin nodular beds of earthy ferruginous character. In this portion of the series the coal bed occurs.

Below this is a hard grey sand-stone, with occasional carbonaceous markings resting upon sandy clay beds in irregular layers; altogether these have an aggregate thickness of about 300 feet, and rest upon brownish sand-stones and pebbly beds with layers of conglomerate, abounding in false bedding, and very irregularly associated. Of these some 250 feet in thickness are seen, and these continue to the base of the hill at the South side.

Another wide plain of irregular undulating ground here stretches for miles, and in it, as in that of Thayet-myo, the more recent deposits of gravel and sand waste all the older series.

Coal.—The coal, where it has been opened upon, is situated on the slope of the hill facing this plain, about 300 feet below the top of the ridge in that part. It was first found exposed in the bed of a small ravine, or mountain stream, which is quite dry, excepting immediately after rain. This small ravine, and of course the two spurs bounding it on either side, runs nearly due North and South.

Immediately at the coal, the section of the rocks was as follows:—

	<i>Descending.</i>	
	<i>Fe.</i>	<i>In.</i>
Clunchy clay, greyish blue, with a few harder layers.		
Black carbonaceous shaly beds, with streaks of coal,	0	9
<i>Coal</i> , with a few thin earthy partings,	4	0
Coaly shale, earthy and carbonaceous,	0	5
Clunchy clay, grey,	3	0
Ferruginous nodular layer,	0	3
Clunchy clay,	1	1
<i>Coal</i> , flaky and laminar,	1	2
Clay, earthy and nodular,	1	8
Sand-stone, hard, grey, with white mica and occasional carbonaceous markings,	10	0
Grey clunchy clay or shale.		

From this it will be seen that there appeared two distinct beds of coal just here; the lower of one foot in thickness and the upper of about 4 feet of coal.

The whole series of rocks described above, and which form one unbroken and conformable sequence of deposit, dips to the N. N. E. In the upper beds the amount of inclination is not more than 25°, but this gradually increases as we descend in the series ; the lime-stone, the coal itself, and the associated beds being at angles from 75° to 85°, or nearly vertical.

In structure this coal is flaky and laminar, composed of alternating layers of bright jetty coal and dark dull earthy carbonaceous shale. In specific gravity, it varies from 1.2 to 1.35. It lights with some facility, burns with good bright and abundant flame, does not intumescence or coke to any extent, the fragments to a great extent retaining their form and burning into hard red cinders, does not clinker, and leaves only a small proportion of ash in *powder*. By a comparative trial of this coal with Raneegunge coal and English, it was found fully equal, if not superior, to the ordinary Raneegunge coal as to its rate of burning or endurance, and decidedly superior in the relative amount of ashes and cinder left after combustion. In this Thayet-myo coal 35.00 per cent. of ash and cinder remained, in the Raneegunge coal 46.6 per cent. These trials were made with the furnaces of the small punching and dulling engine used in the Dock-yard, Calcutta, and under the superintendence of Mr. Jones, the Chief Superintending Engineer, and the details as given by him are quoted below.*

Whatever its real comparative value may have been, for determining which fairly, such a limited experiment was not by any means sufficient, it was obvious that the coal here found was of sufficiently good quality for

* *Statement of trial of Coal sent from Rangoon Naval Dock Yard, by the Chief Superintending Engineer, against Raneegunge and English Coal.*

COAL.	Quantity experimented upon.	Commenced burning.	Consumed at	Time of burn- ing.	Ashes left.
	Mds. Srs.	A. M.	P. M.	H. M.	Mds. Srs.
From Rangoon,	2 23	10 20	1 40	3 20	0 36
„ Raneegunge, ..	2 23	9 53	1 10	3 17	1 8
„ English,	2 23	10 20	2 45	4 25	Scarcely any.

use in the steamers now plying in the Irrawaddy and for the sea-going steamers now trading to Rangoon. While the general importance of a good supply of coal, as connected with the successful navigation of the river, and with the practical development of the resources of British Burmah, could scarcely be too highly estimated.

Under this impression, and with such favourable and promising appearances as I have mentioned, Captain White, Assistant Commissioner at Thayet-myo, had first excavated to the depth of some feet on the beds of coal, where they were exposed on the surface, and had obtained from this excavation some good coal. The report on this was so favorable, that he sought for and obtained the assistance of five men of H. M.'s 29th Regiment, now stationed at Thayet-myo, who had been practically engaged in mining in England and Wales, and whose acquaintance with such operations was of essential service.

A gallery or drift-heading was now commenced a little way down the slope of the hill, with a view to cut the coal below. This was driven in for about 36 yards, when the coal was reached. It is only just to add, that these men, who were under the charge of Corporal Adams, did their work remarkably well. Their progress was undoubtedly slow, but this must be in a great measure attributed to the tools procurable at Thayet-myo, and which were very badly adapted for such operations. Trenching tools may be excellent for their own peculiar purpose, but are not by any means fitted for under-ground work in small headings, nor were any smiths available who could make others.

The advantages of its position also were such as to justify an anxious expectation that the coal would turn out well. From the base of the hill, on which it occurred, to the bank of the Irrawaddy, at Pya-tha-ling, the distance was not more than two miles. For the entire way, there is now an old road used for carting timber and lime-stone, which passes over very favorable ground, and which, for all practical purposes, may be considered a perfect level. There are no streams to cross requiring bridges, and the road could be cleared and put in order for a very trifling sum. The descent from the level of the out-crop to this road is steep, (about 220 feet,) but is over favourable ground, the natural inclination of which is not too great and is continuous and nearly equable. Down this a rude train-road could be very economically constructed, which might easily be worked, either by self-acting inclined planes, or by a drum worked by a pair of oxen. To the head of this incline, the coal

could be brought on a level from the mouth of the mine. For all purposes for which timber could be required in the course of these operations, there is abundance in the immediate vicinity, which could be procured for the expense of cutting, and I think there can be no question that coal, if it existed in this locality, could be worked very economically.

The position of the beds was undoubtedly objectionable. Their nearly vertical arrangement would have necessitated the seams being worked in regular galleries, like a metallic mine ; but this would at the same time have facilitated the unwatering of the works, and the presence of " sulphur " (in parts abundant) was another drawback. But although strong, these objections were not sufficiently so to outweigh the advantages.

There remained then the main question to determine the probable quantity of coal which existed, and the chance of the continuity or permanence of the beds seen at the surface.

When I first visited the place, the excavation which had been originally made, had partly fallen in, and the pit was filled with rubbish and water, so that I could not see clearly the bed, and at that time the under-ground gallery had not reached the coal. There was above a slight appearance of the two beds gradually approaching each other by the thinning out of the intervening beds of clay, &c., but the face of the thicker bed, as then visible, was very promising, and notwithstanding some doubts founded on the analogy of similar rocks elsewhere, I was sanguine that there would be found a good and useful bed of coal, and I was confirmed in this hope, by finding that in a few days afterwards the coal was cut in the heading *precisely* where from measurement I had anticipated it would be. This was the smaller or lower bed, and I then concluded that the other would be found in its relative position within a few feet. I was obliged to leave the place for Prome, and on my return in a fortnight was surprised to find that the miners had gone through all the coal, without recognizing it, and had driven on for some twelve yards farther in the clunch clay. On examination of the pit, however, the facts of the case became obvious. The two distinct beds, which at the surface was seen to be separated by nearly 4 feet 6 inches of clay, &c., had at this depth, about 14 feet below the surface, been brought within 12 inches of each other, while the beds of coals themselves had dwindled down to less than half their thickness. The

thicker bed, which above was 4 feet, was here only 1 foot 8 inches, and the 1-foot bed seen above was here only 5 inches thick. The whole was broken up by several little slips nearly E. and W., and underlying to the N. E. at 80°. Finding this remarkable diminution in the thickness of the beds in depth, a closer examination of the beds at the surface was again made. A small heading was driven on the thicker bed of coal for some feet, and the general character of the deposit thus seen, there too, the greatest irregularity was found. The best seams of bright coal were found suddenly stopped off by masses of clay imbedded in the general seam, or forming lenticular masses in the coal; layers which in one place were bright jetty coal passed within a few inches space into earthy shale; and the whole bed, which when first seen looked a very promising bed of 4 feet in thickness, was broken up into thin and irregular patches of coal mixed with clay. The opposite or Northern end of the excavation was now cleared away. This was about fifteen feet horizontally from the other face, and within that distance I found that the bed, which before appeared to be 4 feet in thickness, was reduced to 2, and was friable poor coal.

I had, in the general examination of the neighbourhood, traced the extension of these coal seams across the spur of the range to the South of the first openings and into the bed of a small mountain stream there, and this I now had opened sufficiently to see the seam, which, however, proved to be only 9 inches in thickness, and therefore useless.

Finding, therefore, that notwithstanding the very promising appearances which were at first presented, and which were certainly very deceptive, that these beds of coal, within the short distance of 15 feet in depth and 15 feet in length, had been reduced to a thickness less than half their original size, and had further become so intermixed with clay and earthy matter as to be useless. I have been reluctantly compelled to advise the abandonment of the works.

As regards the extension of these beds the connection of the coal with the lime-stone above enables us to trace the probable area over which these beds extend, even where there is no actual exhibition of the beds themselves on the surface. To the North of the position of the present excavation, the lime-stone and other beds are curved round gently in the line of their strike and gradually drop from the higher grounds of the hills to the level of the plain below, being cut off by a fault which passes across the range here, and downwards to the South. There is not

therefore an extent of more than 400 yards in this direction in which the coal could be found. No trace of it is seen, and the only indication of its possible existence is the occurrence of a spring strongly impregnated with sulphuretted hydrogen. To the South of the coal again, the lime-stone and associated beds stretch along for less than $1\frac{1}{2}$ mile towards the river, and here also are cut off by a fault, which throws out these beds altogether, so that this remarkable group does not come down to the bank of the Irrawaddy River at all. Along this distance numerous ravines cut the face of the hill and have been carefully examined, but excepting in one within 300 yards of the present coal pits, and immediately adjoining it, no trace of the coal was found. The season, undoubtedly, was very unfavorable for such examination. Every place was covered with the rankest vegetation, and much that would have been visible in the cold weather was thereby concealed. It is therefore just possible that patches of coal may appear, or may be hereafter seen along this escarpment, but I do not at all anticipate that any continuous bed or layer will be met with. The entire series of rocks, as I have mentioned, is of marine origin. Organic remains occur close above the coal, and close below it, which prove that the beds have resulted from deposition on a former sea-bed, and there is nothing, save the existence of the coal itself, and of a few scattered and imperfect markings of vegetable origin in the beds immediately connected with the coal, to point to a fresh-water, or even estuary origin, and I would scarcely hesitate to say that, should other deposits of such fossilized vegetables be discovered in this neighbourhood, they will be found to partake of the same irregular character as that I have above described, and to be nothing more than local patches or local accumulation, on the continuity of which no dependence could be placed.

As regards the geological epoch of these rocks, there is little doubt. The whole group of organic remains, which in some beds occur abundantly, at once, and very definitely, prove that they cannot be referred to the carboniferous or coal measure group of geologists. They are undoubtedly of the old or *tertiary* era, as was originally pointed out with regard to the rocks at Prome (a continuation of the same series as at Thayet-myo) by Dr. Buckland, from a comparison of the specimens collected by Mr. Crawford and Dr. Wallich during their trip to Ava.

I cannot conclude this Report without expressing the high sense I entertain of the exertions of Captain White, Assistant Commissioner at

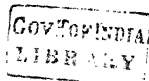
Thayet-myo, in his endeavours to render this coal available, and of the persevering and quiet determination of purpose, with which he steadily followed up every indication of the occurrence of any thing like coal within his District. Were the local Officers in each district to make themselves equally well acquainted with the resources of their neighbourhood, the labours of the Geological Survey would be greatly lightened. The expense incurred in proving this coal (the exact amount of which I do not know) was most entirely justified by the promising appearances it at first presented, and any trials, short of what has been done, I should not have considered satisfactory.

I have also to express my personal obligations for the most friendly and hearty aid which Captain White afforded me in all my enquiries.

(Signed) THOMAS OLDHAM.

The 4th August 1855.

SELECTIONS
FROM
THE RECORDS
OF THE
GOVERNMENT OF INDIA,
(HOME DEPARTMENT.)



Published by Authority.

N°. XVII.
REPORTS
ON THE SURVEY
OF THE
MINERAL DEPOSITS IN KUMAON,
AND ON THE
IRON SMELTING OPERATIONS
EXPERIMENTALLY CONDUCTED AT
DECHOUREE.

Calcutta:
THOS. JONES, "CALCUTTA GAZETTE" OFFICE.

1856.

No. 2658 A. OF 1855.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces,

TO

J. W. DALRYMPLE, ESQUIRE,
Offg. Secy. to the Govt. of India,
Home Department,
FORT WILLIAM.

Dated Head-Quarters, Camp Chatta,
The 26th December 1855.

DEPARTMENT OF PUBLIC WORKS.

SIR,

IN continuation of my letter No. 2363 A., dated the 20th ultimo, I am directed to transmit to you, for the purpose of being laid before the Most Noble the Governor General in Council, copies of the papers noted in the margin, being Mr. Sowerby's Weekly Reports of the Iron Tracts in Kumaon.

Progress Report from September to 14th November 1855.
Ditto ending 24th ditto.
Ditto ending 1st Dec. 1855.
Ditto ending 8th ditto.

I have the honor to be,

SIR,

Your most obedient servant,

W. MUIR,

Secy. to Govt., N. W. Provinces.

Head-Quarters, Camp Chatta, }
The 26th December 1855. }

MR. SOWERBY'S REPORT OF THE SURVEY OF THE IRON
DEPOSITS IN THE BHABUR, &c.

A THOROUGH exploration of the Bhabur Iron Fields having been resolved upon, Mr. Sowerby, an Engineer, late in the employ of the East Indian Railway Company, was selected for the duty, and the Lieutenant-Governor of the North-Western Provinces now submits a Report of that gentleman's proceedings from the 22nd September to the 8th December last.

Several localities have been examined by Mr. Sowerby, some in company with Lieutenant-Colonel Drummond. Of most of these a favorable opinion is entertained, but for a proper understanding of the peculiar advantages possessed by each, it will be necessary to refer to the Reports themselves, as it is intended in this abstract to notice only the more important localities and any general suggestions which are offered by Mr. Sowerby.

The mines of Nutowa Khan Agur, it is stated, yield in large quantities an exceedingly rich description of "Micaceous Specular Iron Ore." Close to the mines are beds of lime-stone, and excellent fire-stone. The mines themselves are well situated, being near the high road and having the advantage of the Ramghur stream, which never becomes dry. The timber in the immediate neighbourhood has been used up, but the surrounding Hills are thickly covered with oak trees.

Mr. Sowerby has examined an iron mine at Oojoulee, near the Western end of the Loha Kôt, which was occasionally worked by the inhabitants to some extent. The ore is stated to be a rich red oxide of a specular appearance and is embedded in a micaceous clay slate with white crystalline lime-stone. The beds are not regular, and situate at an elevation above the Kossilla River of about 3,000 feet. Half way down the Hill, there being a mountain stream, which never becomes dry, the ore could be brought down by means of inclined drops or spouts with facility and economy.

The iron ore near the Khyrna Bridge is stated to be a rich red hæmatite, like the ores in Cumberland and Lancashire. It is not in regular beds, but large caverns. The enclosing rock is clay slate, exceedingly hard and compact. From all appearances, the deposit is very considerable, and there is a good back Hill to work upon. Timber is abundant in the neighbourhood, and the Kossilla River will supply water to any extent.

The Pass behind Chenur is considered one of the best routes for connecting the mines of the Agur District with those of the Bhabur. The Pass is low and quite practicable for a pony or bullock road. He cannot speak of the possibility of making a tramway to be worked by water-wheels.

In Dechouree, farther up the Boer stream, he has found a bed *in situ* exposed to a thickness of about 20 feet and upwards, at about half a mile beyond the previously ascertained beds. The works at Dechouree

are now being steadily proceeded with, and all descriptions of works there are in fair progress. In the District between Dechouree and Ramnuggur, there are no indications of iron-stone, nor up the Kossilla River as far as Duckalee. The jungle from Dechouree to Bhoonka has been cleared, and iron ore found on both sides of the deposit at Dechouree in large masses and of good quality.

Mr. Sowerby has selected convenient sites on the Southern side of the Boer stream for an experimental furnace ; but the river is said to be very low during the dry months, owing to its heavy discharge in its various parts. The supply of water, he states, may be kept up by bunds or compensating reservoirs, or by having high falls and large wheels, and bringing the water down in well-constructed brick culverts. Before constructing the bunds and reservoirs, Mr. Sowerby recommends the retentive or porous character of the ground, the slope and other important circumstances to be carefully decided upon. A small auxiliary steam engine might, he thinks, be used during the dry months. This will entail a small additional expense, fuel being abundant and cheap. The works, he adds, ought to be carried on in different places, in order to prevent the rapid consumption of fuel in one particular part of the forest.

Near the village of Bhuggur a ferruginous bed has been discovered. Though at its exposed part, it is not a proper iron-stone, but more like clay-stone, with good deal of iron, it requires to be dug into to prove its true character.

From Loha Bhur Bhur to Dereekara, there are seen for a distance of about 300 feet blocks of brown iron. At several places the stone is seen out cropping, but not much exposed. Here is also found white fire-clay.

The iron ore near Bhoonka has been traced until it terminates in a high precipice. The precise dimensions of the bed cannot be stated until the jungle is cleared, which is being done. Huge blocks are found opposite the village of Bhoonka.

A path has been cut through the jungle, from the high scar at the West end of Loha Bhur Bhur towards Bhoonka, and a bed in large masses has been discovered in three different places. It is a rich brown iron ore of a metallic appearance when fractured. Mr. Sowerby attaches much importance to the finding out of these beds, as it settles the question as to the character of Loha Bhur Bhur deposits and their continuity.

A bed of clay iron ore has been discovered at Beejapoor, near Huldwanee, of 30 feet in thickness. A level is made on the hill-side for a distance of about 100 feet, which is through iron ore and iron soil, and there are indications of the bed being continuous longitudinally. The iron ore is rather rich, but more friable than the beds of Loha Bhur Bhur and Dechouree. It is slightly metallic when broken, and small flakes of white clayey matter are interspersed in the bed. Immediately beneath the bed is one of white fire-clay. There is lime-stone at places within 2 or 3 miles of the mine, and a stream below the bed of iron ore, which is small and becomes dry in the hot weather, but the Golah River, which is 2 miles distant, can supply any amount of water power. The fuel is abundant and the unhealthy part of the jungle is already cleared, and the country towards the Plains is open.

The first result of clearing of the jungle has been the exposure of the bed of iron ore on both sides of the above-mentioned small stream. On the right bank the bed is of considerable thickness and the ore is of good quality, but covered with detritus, which is being removed. The advantages of Beejapoor render it peculiarly adapted for works on an extensive scale for smelting and manufacturing of iron.

At Chownisilla he has found in two dry streams small rolled blocks of iron-stone, which he has traced to their original bed in a ravine in the Hills, 2 miles North of the high road. The blocks when fractured have a very metallic lustre, are heavy, and contain a good per-centage of iron. Here also he met with white clay and a thin seam of coal. Similar seams were noticed at Bumooaree above the dawk bungalow and up the Boer River. The coal would be exceedingly useful for railway purposes, and therefore an investigation is desirable.

Owing to the density of the jungle he has not been able at present to examine the deposits to the Eastward of Huldwanee. He will be better able to do this in a month hence, and till then would confine his researches to the Westward.

In the neighbourhood of the Kossilla River, and immediately after crossing the dry bed of the Dubka, an iron bed is seen in a ravine, and in a North-west direction the bed is successively seen out cropping in several places to the North of the village of Umraihee (Ghora Kôt,) and lower down towards the river the bed is exposed to a thickness of about 20 feet from Umraihee to Banranee Nuddee, East of Dat Kôt. The ore is a brown clay, kind of a slight metallic lustre when fractured; it is

poor, but the specimens in thicker parts of the exposed bed are rich and heavy. The ore is often spotted with pea-like crystals. Mines are being dug to ascertain the true character of the deposit in this locality. The specimens from the Western bank of the river are heavy and resembles the best quality of Beejapoor ore. The local position of the ore on the Kossilla is adapted for the establishment of large works. Hackeries can go higher up, and the water power is great.

In a ravine branching off from the Khuddharee Nuddee, close to Ghora Kôt, iron-stone is found in huge blocks to a considerable distance and in large quantities. The ore is a red and brown clay iron ore. The Khuddharee Nuddee is nearly dry. There is lime-stone in the neighbourhood and a dense forest all round. This discovery is considered important, being between two large streams. Water in the Kitcheree is considerable, at the point where works would be erected. From works established there, the bed of iron ore would be easily brought down by tramway laid from the mines. The discovery of the continuity to the Westward may be regarded exceedingly satisfactory.

Near a place called Bhora Kôt, some few specimens of iron ore have been found, and beyond Bhora Kôt there are large blocks of highly ferruginous quartz rock, with a great deal of iron ore. Some are exceedingly rich and heavy, but being mixed with quartz of a crystalline character, it will be refractory in the furnace, and may prove useful for mixing with other ores. No bed has been discovered, but the indications are favorable.

At Latee Bullena, some ferruginous quartz, with iron ore, has been discovered. The specimens obtained below the surface are of a deep crimson color resembling cinnabar; being associated with quartz, it is refractory, but may be useful in mixing with the very fusible ores of the newer rocks.

Mr. Sowerby has examined the plumbago deposits in several localities in the neighbourhood of Almorah, where openings had previously been made, and where plumbago, either of an inferior kind or that of the best quality, in very small quantities, have been found. The extent of the country over which there are indications of this mineral is about 15 miles. The formation is a highly micaceous clay-slate. In many places the ground is greatly dislocated and disturbed, a circumstance which renders mining difficult and requires great skill and judgment. The openings have been superficial and never carried to an extent to prove

the true character of the deposits. The ground therefore should be thoroughly explored, and mining on a proper plan would prove successful, if carried on by persons acquainted with this particular work. He has advised Colonel Drummond to suspend it until he could superintend the work himself, or employ some competent person to do so.

At Chownsilla alum has also been found as an efflorescence on the rocks (sand-stones.)

Mr. Sowerby speaks very favorably of the laborers who have worked under him, and expresses a hope that they will hereafter prove useful as miners.

(COPY.)

No. 408 OF 1855.

FROM

J. H. BATTEN, ESQUIRE,
Commissioner of Kumaon,

TO

W. MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces.

Dated Camp Kaleedoongee, the 25th November 1855.

GENERAL DEPARTMENT,

PUBLIC WORKS.

SIR,

I HAVE the honor to forward for the information of the Hon'ble the Lieutenant-Governor of the North-Western Provinces the accompanying Report of Progress by Mr. W. Sowerby on special duty in this Province.

I have the honor to be, &c.,

(Signed) J. H. BATTEN,
Commissioner.

KUMAON COMM'R.'S OFFICE; }
Camp Kaleedoongee, }
The 25th November 1855. }

(COPY.)

HIMALAYAN IRON WORKS, KUMAON.

PROGRESS REPORT OF THE SURVEY OF THE IRON DEPOSITS IN THE
BHABUR, &c. BY W. SOWERBY.

HAVING received instructions to further investigate the deposits of iron ore in the Lower Hills, the following is a Report of Progress made in this Survey from the 22nd September up to the 14th of November.

Owing to the reputed unhealthy state of the Bhabur during the latter part of September and the early part of October, together with the difficulty of obtaining laborers there during that period, I was strongly advised to defer proceeding there then.

At the suggestion of Lieutenant-Colonel Drummond, I accompanied him into the interior of the Province to examine the iron deposits, a short distance within the Hills, with the view of ascertaining their extent and the practicability of economically working them in connection with the mines of the Bhabur.

On the road from Nynce Tal to Almorah, about one-quarter of a mile on this side of Sham Ket, I noticed a ferruginous bed indicating an iron deposit, and a short distance beyond the stream where the native houses are situate, I picked up a small piece of iron-stone of tolerable good quality.

About 2 miles beyond the Ramghur dawk bungalow, near the high road, I was shown several pits, which had been dug by the native miners for obtaining iron ore, specimens of which I obtained. It is an exceedingly rich description of micaceous specular iron ore, and is said to be obtainable in any quantity, which I consider highly probable. The Ramghur stream had plenty

of water in it for water power, and from enquiries on the spot it never becomes dry. A bed of lime-stone I also noticed *in situ* and excellent fire-stone, both a short distance from the iron mines. The timber immediately over the mines has been used up by the native smelters, but the surrounding Hills are thickly covered with oak trees, forming

a dense forest from the Ramghur stream to the summits of the highest peaks. This is in the Agur District.

When at Almorah, I was requested by Lieutenant-Colonel Drummond to examine the plumbago deposits in the surrounding neighbourhood. The first indications of plumbago is the black appearance of the soil in numerous places, especially on the Hurredongee Hill and on Kaleemut. I went over to the village of Pulseemee, where openings have been made, in order to try the ground, and out of which an inferior kind of plumbago has been obtained. I continued my examination up the Valley of the Sal River as far as the village of Puthownee, where several other openings had been made, and from which the best quality of plumbago has heretofore been obtained, though in very small quantities. I picked out several good pieces from the rock. Beyond Kaleemut I visited several other openings, where the results arrived at had been similar to those at Pulseemee. The extent of country over which these plumbaginous appearances and indications are found is very considerable, probably 15 miles. The formation is a highly micaceous clay-slate. The ground however is in many places greatly dislocated and disturbed, thereby rendering the mining much more difficult, and consequently requiring very great skill and judgment. The openings that have been made were done to try the ground, and though in many places they go a great way in, they are still comparatively superficial, and in no case have they been carried on to an extent to prove the true character of the deposits, or to enable any one to say that the mineral can be obtained, either in quantity or quality, to be worth working or otherwise. The ground should be more thoroughly explored, and wherever it is found comparatively settled, mining on a proper plan, and to a sufficient extent, would I believe prove successful. The spot for commencing operations must be carefully selected by some one acquainted with this particular kind of mining, and the work must be well directed. Without this is done, I fear that partial attempts would lead to nothing satisfactory, but would act as a discouragement to future efforts; I therefore advised Lieutenant-Colonel Drummond to suspend any further work until he either had time at his disposal to superintend the work himself, or until it was placed in the hands of some person who was competent to do so.

I next proceeded down the Valley of the Kossila, accompanied by Lieutenant-Colonel Drummond, and Mr. Davies, Mines of iron at Oo-joulee, the smelter. At Oojoulee, near the Western end of the Loha Kôt or Iron Mountain in the Agur District, we examined an iron mine occasionally worked by the inhabitants. The ore is a

rich red oxide of a specular appearance, and is found embeded in a micaceous clay-slate, accompanied with white crystalline lime-stone. The bed or beds have been partially worked, but to no great extent. They are exceedingly thick, but not very regular, and situated at a very great elevation above the Kossilla River, probably 3,000 feet and upwards. About half way down the Hill the path crosses a mountain stream which never becomes dry, and may at some subsequent period become serviceable for water power. Bringing the ore down from so great an elevation would not be accompanied with much difficulty, as it could be brought down by means of inclined drops or spouts, similar to the coal spouts on the Tyne, with great facility, and at a comparatively trifling expense.

I next visited a deposit of iron ore near the Khyrna Bridge: this is at the confluence of the Ramghur and Kossilla Rivers. The ore is a rich red hæmatite, precisely similar to the same ores found in Cumberland and Lancashire: it is not found in regular beds, but large caverns. The ore has been worked slightly by the native miners, as seen in several irregular openings made by them close to the bridge. The enclosing rock is clay-slate, exceedingly hard and compact; the ore is seen in several places in a high scar facing the river; and from the extent to which it is seen, I have no doubt whatever, but that the deposit is very considerable, and there is a good "back" (hill) to work upon. This mine has been the subject of notoriety from the circumstance that the materials for the iron bridge were brought from England, and one end of it is built into a rich mine of iron. Timber is abundant in the neighbourhood of the mines last mentioned, and the Kossilla River will supply water to any required extent, being a very large stream.

From Khyrna, I went up to the village of Jâk, to examine the Pass behind Chenur; this Pass being, according to the opinion of Lieutenant-Colonel Drummond, one of the best routes to be taken for connecting the mines of the Agur District with those of the Bhabur. The Pass appears low and quite practicable for a pony or bullock road, but I cannot yet give a decided opinion on the possibility of making a tramway to be worked by water-wheels, as suggested by Lieutenant-Colonel Drummond.

From Jâk I proceeded again to Dechouree and continued the research farther up the Boer stream, with a view of ascertaining the continuity of the bed in that direction.

beyond the point mentioned in my previous observations respecting this deposit, and the result was the finding of the bed *in situ* exposed to a thickness of about 20 feet and upwards. This was at a point about half a mile beyond the previously ascertained beds. I also noticed a slight indication high up the hill-side to the Eastward of the beds already described in my former observations.

I accompanied Mr. Davies and Lieutenant-Colonel Drummond to fix upon a site for an experimental furnace. At the Site for an experimental furnace. Dechouree side of the river there were many difficulties to contend with, that it was considered advisable to fix upon the opposite side of the river, on one of the natural terraces of level ground. On this side there is a succession of terraces, with narrow strips of level ground rising gradually from the bed of the river until they attain an elevation of about 150 to 200 feet. Each strip is from 30 to 40 feet higher than the other and these strips of land are cultivated and irrigated by a succession of small streams or gools formed by the cultivators. It was therefore considered advisable to fix on a site close to one of the streams of water, which would greatly facilitate the making of the experiment and lessen the expense.

In selecting the Southern side of the river, it was considered that great facilities were afforded in gaining access to the Plains and in establishing residences for European head-workmen. The facility, too, with which a succession of furnaces could be built at the sides of the steep banks or steps and the ready means of getting a natural fall of water, the same water being used for driving a succession of wheels, and finally allowed to pass on to the land for irrigation, rendered the Southern side of the river by far the most desirable. It now appears that the quantity of water in the River Boer becomes exceedingly small during the dry months, namely April and May, when it is said to be but 10 cubic feet per second. The exact quantity however does not appear to be precisely known, as there are many contradictory statements. This is I think owing to the discharge being various in different parts of the river, according as the bed is retentive or otherwise; and immediately opposite the village of Dechouree the bed of the river is very porous and the stream becomes small, whereas higher up it becomes larger, though narrower and more impetuous; and lower down, where the new canal is taken off, it is said to be equal to 50 cubic feet per second.

Something, however, may be done in the way of bunds and compensating reservoirs placed laterally for keeping up the supply of water, and a great deal may also be done by making the most of a small supply by having high falls and large wheels and bringing the water down in well-constructed brick culverts to prevent evaporation and escape. By this means the water will probably be sufficient to work the machinery of four or six furnaces. (They should be erected in pairs.) The construction of bunds and reservoirs is attended with some difficulty, depending greatly on the retentive or porous character of the ground, the slope and other important circumstances; and before being decided upon, they should be well considered, and should form part only of some complete arrangements and plans, otherwise they may prove useless and do a great deal more injury than good. A small auxiliary steam engine might be used during the dry months. This

Auxiliary steam power. would entail only a small additional expense, especially where fuel is so abundant and cheap. It is not desirable to have all the works concentrated on one spot, where a rapid consumption of fuel would take place, whilst other parts of the forests would remain untouched. It will therefore be found to be no inconvenience to have the works carried on in different places, and before long, communication will be opened out to points on the banks of large rivers, as the Kossilla and Ramgunga and Golah, where water power can be obtained and where fuel is abundant, though iron-stone may be scarce; and the additional expense of transporting the ore on common tramways will be found no serious expense in the production of iron.

At a distance of about 3 miles up the River Boer, near the village of Bhuggur, a highly ferruginous bed has been discovered, exposed by the action of the river. Iron bed up the Boer River at Bhuggur. It is not at its exposed part a proper iron-stone, but more of the character of a clay-stone, containing a good deal of iron. It looks very metallic when fractured. This bed will require to be dug into to prove its true character.

I have now traced the iron bed from the Loha Bhur Bhur to Dereekalkara, where the blocks of brown iron-stone are seen up the side of the Hill for a distance of about 300 feet and a length of about five chains (say 300 feet.) An opening had been made here by Lieutenant-Colonel Drummond, but it is now fallen in at several places intermediate. Between Loha Bhur Bhur

and Derealkara the stone is seen out cropping, but not very much exposed. Here also I have found the white fire-clay.

To the Westward of the previously ascertained bed at Loha Bhur Iron ore near Bhoon- Bhur, the ore has been traced until it terminates ka. in a high abrupt scar or precipice of solid iron ore. The bed has heretofore been seen only on its longitudinal face. At this precipice, however, a cross section can be seen, which shows it to be of great extent, but the precise dimensions of the bed cannot be properly stated until the jungle is cleared, which is now being done. The bed has also been partially traced until opposite the village of Bhoonka, where the huge blocks are found exactly as at Loha Bhur Bhur.

I have examined the deposit at Beejapoor, where Lieutenant-Colonel Beejapoor, near to Huld- Drummond had made an opening. This however wance. had fallen in. This opening I have since my first visit had again opened out, and the result is the exposure of a bed of iron ore (clay iron ore) of at least 30 feet in thickness. A level has been driven into the hill-side for a distance of about 100 feet, the whole of which is through iron ore and iron soil. The bed is quite undisturbed and unbroken, and the ground settled. Several smaller openings had been made by Lieutenant-Colonel Drummond on each side of the larger one, where the bed was again come upon, and I found several small blocks of the iron ore in dry ravines at distances of five or six chains on each side of the large opening clearly indicating the bed to be continuous longitudinally. I have directed the jungle to be cleared, and further openings to be made forthwith. The iron ore is rather rich, but more friable than the beds of Loha Bhur Bhur and De-chouree. It is slightly metallic when broken, and small flakes of white clayey matter is interspersed in the bed. Immediately beneath the bed is a bed of white fire-clay. Lime-stone is obtainable at several

Lime-stone. places within a distance of 2 or 3 miles of the mine. There is a stream immediately below the bed of iron ore, which is only small, and becomes dry, or nearly so, during the hot weather, but the Golah River, which is only 2 miles distant, is sufficient to supply any amount of water power that may be required. The minimum discharge is about 200 cubic feet per second in the dry months, and as this river derives its supply, not only from the drainage of a large area and numerous springs, but also from Nynee Tal, Beehm Tal, Non Kutchea Tal, and Mulooa, it may be assumed that the supply is

never likely to fail, but that it might be very considerably increased if necessary. The fuel here is as abundant as at any other part of the Bhabur, and the unhealthy part of the jungle is already greatly cleared; and towards the plains the country is beautifully open and free from obstruction. The many advantages of this place appear to point it out as peculiarly adapted for the establishing of works on an extensive scale for the smelting and manufacturing of iron. This however will be more completely discussed in a final Report.

At Chownsilla, a village half way between Huldwanee and Kaleedoon-gee, in two dry streams I found small rolled blocks of iron-stone. The specimens first found appeared to have been carried some distance by the river. I have now traced these blocks to their original bed, which I found in a ravine in the Hills about 2 miles North of the high road. The blocks near the bed are about 2 cubic feet in size, and when fractured have a very metallic lustre. They are heavy and contain a good per-centage of iron, but not equal to Dechouree. They differ also from other Bhabur specimens I have yet seen, in being associated with a good deal of silicious matter. The bed is but little exposed, and will require to be excavated. Here also I found the white clay, and close at hand I found a thin seam of coal. I also noticed similar seams at Bumoooree above the dawk bungalow and likewise up the Boer River. The coal resembles, and is, I think, a lignite, though occasionally slightly bituminous, but it appears only in short irregular thin patches, and nothing like regular beds. The abundance of wood fuel renders it unnecessary to search for coal for smelting purposes, but it would be exceedingly useful for railway purposes. It would therefore be very desirable to fully investigate these coaly appearances.

At Chownsilla, I have also found alum appearing as an efflorescence on the rocks (sand-stones.) I am not aware of the value of this mineral in India, nor have I examined as yet into the probable supply—it may, however, be worthy of notice in passing.

With regard to the deposits to the Eastward of Huldwanee, the jungle is just at present so very dense, that it would be difficult to penetrate it. The statements of Lieutenant-Colonel Drummond in his Report have however been proved to be so faithful and correct at all places which I have visited,

that there need not be the slightest hesitation in relying fully upon whatever statements he has made in his Report with regard to the deposits to the Eastwards, and as these can be much better visited a month hence, it would appear advisable to continue the research at present to the Westward on ground already unexplored.

The works at Dechourée are progressing favorably ; the greater part of the timber and wood-work is cut and dressed ; the foundations are now being dug for the furnace, and an excellent stone quarry has been discovered close at hand.

I cannot close this Report without expressing my satisfaction at the excellent character of the laborers. In the course of one week fourteen men had executed an amount of labor at the Beejapoor mine to such an extent, that it augurs well for their future usefulness as miners, and for success of future works.

(Signed) W. SOWERBY,
Engineer in charge.

KALEEDOONGEE, }
The 14th November 1855. }

(COPY.)
No. 441 OF 1855.

FROM

J. H. BATTEN, ESQUIRE,
Commissioner of Kumaon,

TO

W. MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces.

Dated Camp Kaleedoongee, the 30th November 1855.

GENERAL DEPARTMENT,
PUBLIC WORKS.

SIR,

I HAVE the honor to forward a Weekly Report of Survey, &c. from Mr. W. Sowerby, Engineer in charge.

I have the honor to be, &c.,
(Signed) J. H. BATTEN,
Commissioner.

KUMAON COMM'R.'S OFFICE ; }
Camp Kaleedoongee, }
The 30th November 1855. }

(COPY.)

HIMALAYAN IRON WORKS, KUMAON.

PROGRESS REPORT OF SURVEY, &c. FOR THE WEEK ENDING 24TH
NOVEMBER 1855.

Survey.

THE clearing of the jungle has been fairly commenced at Dechouree,
and the first result has been the exposure of the
Dechouree. iron ore in large masses, and of good quality,
immediately beyond the broad open ravine mentioned in a former Re-
port. Mr. Commissioner Batten visited the place a few days ago and
expressed his satisfaction at this new discovery. It is very close to the
furnace now being built.

The clearing of the jungle has also fairly commenced at this important
Beejapoor (Huldwa- point, which is within a short distance of the Golah
nee.) River, and it is satisfactory to have to report that
the first result of this clearing has been the exposure of the bed of iron
ore on both sides of the small stream near which it is found. On the
right bank the bed is seen to a considerable thickness (probably 40 feet,) but is greatly covered with detritus, which is now being removed. The
specimens of ore obtained are more free from the flakes of white clay
mentioned in a former Report and are of a decidedly better quality on the
left bank of the stream. The ore is not exposed to a great thickness: this
is in a direct line with the stroke of the bed from the former opening,
and about one-quarter of a mile distant, and it clearly and distinctly
shows the continuity of the bed in a longitudinal direction. The old
opening now exposes the bed to a thickness of 50 feet.

Pieces of iron ore have been obtained from points further up the small
ravine, but the search is now being continued on towards the Bumouree
bungalow, a point on the banks of the Golah River.

Several specimens of good lignite have been
obtained from this place, and also a few pieces of
Futtehpoor. good iron ore: it is apprehended however that the
Chownsilla. bed lies deep.

Some small specimens have been obtained from the Westward near
Kolah, and the search is being carefully carried on
Westward of Dechou- in that direction.
ree.

The works at Dechouree are now being steadily proceeded with; the
foundations for the furnace have been built, and
Dechouree experimen- the walls are 4 feet above the foundations,
tal works.

The making of the fire-bricks has been found somewhat difficult, owing to the material used being quite new to the native workmen. The first difficulty has been overcome and the work is proceeding satisfactorily. Nearly the whole of the timber has been cut and prepared for the wheel and other machinery, and the framing is now being put together.

A hackery road has been opened to Kaleedoongee at an expense of Rupees 30.

(Signed) W. SOWERBY,
Engineer in charge.

The 28th November 1855.

(COPY.)

NO. 415 OF 1855.

FROM

J. H. BATTEN, ESQUIRE,
Commissioner, Kumaon Division,

TO

W. MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces.

Dated Camp Huldwanee, the 6th December 1855.

GENERAL DEPARTMENT.

SIR,

I HAVE the honor to forward Weekly Progress Report ending 1st December 1855, from Mr. W. Sowerby, Engineer in charge.

I have the honor to be, &c.,

(Signed) J. H. BATTEN,
Commissioner.

KUMAON COMM'R.'S OFFICE ;
Camp Huldwanee,
The 6th December 1855. }

(COPY.)

HIMALAYAN IRON WORKS, KUMAON.
WEEKLY PROGRESS REPORT, DECEMBER 1ST. 1855.

Survey.

Westward.

The Survey to the Westward has been continued during this week, and the following are the results :

The District in a line from Dechouree to Ramnuggur is a series of undulating Hills and Doons, sections of which Dechouree to Ramnuggur. to a good depth and length are obtained in crossing the Dubka, Kitcheree, and Kossilla Rivers. These sections show the strata to be chiefly alternate beds of gravel, soft sand-stone, boulder beds, and a kind of hard conglomerate of lime and gravel lying nearly horizontal. There are few or no indications of iron-stone in this District, nor up the Kossilla River as far as Duckalee. To use a native phrase, the Hills are not pukka.

From Duckalee to Setee the indications are also very few.

Near a place called Bhora Kôt up the Huttoulea Nuddee, in a kind of ferruginous killas, some few specimens of iron ore near Bhora Kôt. ore have been found, and beyond Bhora Kôt, a short distance to the Eastward, there are large blocks of highly ferruginous quartz rock, with a great deal of iron ore, similar to the rich ore found in the interior at Ketsaree. Some pieces are exceedingly rich and heavy, but being associated with quartz of a crystalline character, it will be very refractory in the furnace, and may become useful for mixing with the other ores. No bed has been discovered, but the indications are very favorable. There are beds of ferruginous killas in the same locality : this is between Bullona and Pât Kôt.

A little to the North of Pât Kôt, the geological formation is the same as at Bhora Kôt, namely, a kind of ferruginous Iron ore at Pât Kôt. killas, with small blocks and pieces of very rich iron ore, but nothing like a bed of any extent has been found in this locality.

To the South-east of Pat Kôt, near the village of Ghora Kôt, iron-stone of the same character as that found at Dechouree and Loha Bhur Bhur has been discovered in the sand-stone formation. In a ravine branching off from the Khuddharee Nuddee, close to Ghora Kôt, the iron-stone is seen in huge blocks lying on the slope of the Hill for a considerable distance, exactly the same as at Dechouree and Loha Bhur Bhur, and in as great quantity as at those places. The ore is a red and brown clay iron ore as at the two places above named. The Khuddharee Nuddee is a small tributary stream of the Kitcheree River and it is nearly dry, but at the Kitcheree River, which is about one

mile distant, it is stated by the inhabitants that there is plenty of water. This requires to be verified. There is lime-stone in the neighbourhood, and a dense forest all round, continuing from this point (Ghora Kôt) to nearly the Dubka Nuddee, a distance of $2\frac{1}{2}$ or 3 miles. The iron ore is found in blocks and masses up all the ravines and along the hill-sides. Almost every other stone is a block of iron-stone. No excavation has yet been made to expose the bed *in situ*. The Dubka is nearly dry at the point where the line crosses, but higher up and lower down there is a good supply of water. This discovery is important, being between two considerable streams, and proves the deposit to continue in a Westerly direction.

Kossilla. A research is now diligently made on the banks
Patlea Doon. of the Kossilla ; information has also been received
that iron ore is found in the Patlea Doon.

The jungle has been cleared in this locality and iron ore has been
found on both sides of the deposit at Dechouree
formerly described.

Several very rich specimens of iron-stone have also been obtained
from the point formerly mentioned up the Boer
River near Bhuggur.

From Futtehpoor, near Chownzilla, several very rich and heavy speci-
mens of iron-stone have been obtained of differ-
ent qualities.

Beejapoor. This locality is now being fast cleared of
Huldwanee. jungle.

Dechouree works. The works at Dechouree are being carried on as
rapidly as possible.

The first batch of fire-bricks has been drawn from the kiln ; as was
expected, the bricks are not of the first-rate quality, but they are never-
theless a fair sample.

The furnace is built up to the arches, which are now nearly half-built.
The timber for the machinery (wheel, &c.) has been nearly all cut and
dressed, and the framing is being fast put together.

Tramway. The wood for a short tramway has been partly
cut, and will be forthwith laid down.

(Signed) W. SOWERBY,
Engineer in charge.

The 4th December 1855.

(Copy.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF WORK DONE AT DECHOUREE

Dechcuree, 3rd December 1855.

DATE AND MONTH.	Days of the Week.	Carpenters.	Sawyers.	Stone-masons.	Black-smiths.	Brick-makers.	Coolies.	REMARKS.
26th November 1855,	Monday, ...	21	8	25	2	10	183	The workmen and coolies employed as the previous week. The wood-work is nearly all completed ; jungle cut, and temporary roads formed. (Signed) W. S.
27th Ditto,	Tuesday, ...	21	8	25	2	10	182	
28th Ditto,	Wednesday, ...	21	8	25	2	10	182	
29th Ditto,	Thursday, ...	21	8	36	2	10	182	
30th Ditto,	Friday, ...	21	8	36	2	10	182	
1st December 1855,	Saturday, ...	21	8	36	2	10	182	

(Signed) REES DAVIES,
Superintendent.

(Signed) W. SOWERBY,
Engineer in charge.

The 4th December 1855.

(20)

(COPY.)

No. 425 OF 1855.

FROM

J. H. BATTEN, ESQUIRE,
Commissioner, Kumaon Division,

TO

W. MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces.

Dated Camp Huldwanee, the 15th December 1855.

GENERAL DEPARTMENT.

SIR,

I HAVE the honor to forward Mr. Sowerby's Report of Weekly Progress at Dechouree, &c. I also beg to enclose a previous Report, No. 2, which by some mistake was retained in this Office.

I have the honor to be, &c.,

(Signed) J. H. BATTEN,
Commissioner.

KUMAON COMMR.'S OFFICE ; }
Camp Huldwanee, }
The 15th December 1855. }

— — —

(COPY.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF WORK DONE AT DECHOUREE.

DATE.	Days of the Week.	Carpenters.	Sawyers.	Bricklayers.	Stone-masons.	Quarry-men.	Coolies.	REMARKS.
1st Nov. 1855,	Thursday, ...	10	8	0	0	0	17	Carpenters and sawyers employed in felling trees and squaring timber for machinery and coolies in digging foundation for furnace.
2nd Ditto, ...	Friday, ...	10	8	0	0	0	17	
3rd Ditto, ...	Saturday, ...	10	8	0	0	0	17	

(Signed) REES DAVIES,

Superintendent.

The 16th November 1855.

(Signed) W. SOWERBY,

Engineer in charge.

(Copy.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF WORK DONE AT DECHOUREE.

DATE.	Days of the Week.	Carpenters.	Sawyers.	Bricklayers.	Stone-masons.	Quarry-men.	Coolies.	REMARKS.
5th Nov. 1855,	Monday, ...	10	8	0	0	0	17	Carpenters and sawyers employed in felling trees and squaring timber for machinery and coolies in digging foundation for furnace and bringing timber from jungle.
6th Ditto,	Tuesday, ...	10	8	0	0	0	17	
7th Ditto,	Wednesday, ..	10	8	0	0	0	17	
8th Ditto,	Thursday, ...	10	8	0	0	0	17	
9th Ditto,	Friday, ...	10	8	0	0	0	17	
10th Ditto,	Saturday, ...	10	10	0	0	0	46	

(Signed) REES DAVIES,
Superintendent.

The 16th November 1855.

(Signed) W. SOWERBY,
Engineer in charge.

(Copy.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF WORK DONE AT DECHOUREE IN NOVEMBER 1855.

DATE.	Days of the Week.	Carpenters.	Sawyers.	Bricklayers.	Stone-masons.	Quarry-men.	Coolies.	REMARKS.
12th Nov., ...	Monday, ...	11	8	0	0	0	46	Carpenters and sawyers employed in felling trees and squaring timber for machinery; coolies in digging furnace foundation, clearing stone quarry, making road, and clearing away the jungle.
13th Ditto, ...	Tuesday, ...	11	8	0	0	0	56	
14th Ditto, ...	Wednesday, ...	11	8	0	0	0	57	
15th Ditto, ...	Thursday, ...	12	8	0	0	0	60	
16th Ditto, ...	Friday, ...	12	8	0	0	0	94	
17th Ditto, ...	Saturday, ...	12	8	0	0	0	99	

(Signed) REES DAVIES,
Superintendent.

The 17th November 1855.

(Signed) W. SOWERBY,
Engineer in charge.

(Copy.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF WORK DONE AT DECHOUREE.

Dechouree, 19th November 1855.

DATE.	Days of the Week.	Carpenters.	Sawyers.	Stone-masons.	Quarry-men.	Brick-makers.	Blacksmiths.	Coolies.	REMARKS.
19th, ...	Monday, ...	13	8	18	0	5	4	181	{ Carpenters preparing frame-work for wheel, &c. &c.
20th, ...	Tuesday, ...	13	8	18	0	5	4	177	{ Sawyers felling timber and sawing it for frame-work.
21st, ...	Wednesday, ...	13	8	20	0	5	2	175	{ Stone-masons building furnace foundation.
22nd, ...	Thursday, ...	13	8	20	0	5	2	174	{ Brick-makers making bricks and preparing brick-kiln.
23rd, ...	Friday, ...	13	8	20	0	5	2	174	{ Blacksmiths making and repairing tools, &c.
24th, ...	Saturday, ...	13	8	24	0	5	2	173	{ Coolies cutting tramway road, clearing jungle, carrying stones, &c.

(Signed)

W. SOWERBY,

Engineer in charge.

(Signed)

REES DAVIES,

Superintendent.

The 27th November 1855.

(COPY.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF SURVEY, &c.

The 8th December 1855.

THE iron deposit has now been successfully traced from the Dubka River up to and beyond the Kossilla River. Discovery of iron bed up to the Kossilla River. Immediately after crossing the broad dry bed of the Dubka, a little to the North of a village called Ghutoorah, the iron bed is seen in a ravine, and from this point, in a nearly North-west direction, the bed is successively seen out-cropping in a great number of places, sometimes to a considerable extent and thickness, at other places intermediate, small blocks of it are found lying on the surface, and here and there larger blocks. Those outcrops and blocks continue up to the ravine a little to the North of the village of Umraihee (Ghora Kôt) mentioned in the last week's Report, where the huge blocks are found scattered on the surface as at Loha Bhur Bhur, for a distance of half a mile, and lower down towards the river the bed *in situ* is seen exposed to a thickness of about 20 feet and upwards from Umraihee to the Bunranee Nuddee at the Eastern side of Pât Kôt. It is found in various ravines and on the Hill slopes, in large and small blocks.

In the deep ravine of the Bunranee Nuddee, the bed has been cut through by the river, and is found at a considerable depth in the ravine exposed in a high precipice. It alternates, or is embedded in the sand-stone formation, dipping a little to the West of North at an angle of about 25°. Owing to the dense jungle on the steep hill-side and surface soil, the precise thickness of the bed could not be readily ascertained. The ore remains of the same character as at Loha Bhur Bhur, namely, a brown clay ore of a slight metallic lustre when fractured. When near the surface and a good deal weathered, it is poor, but the specimens found in thicker parts of the exposed bed are rich and heavy in the hand. Frequently the ore is spotted with pea-like crystals. On the gently sloping ground South of Pât Kôt the bed is not seen, nor any indications, but beyond this point on the hill-sides, and in the ravines, in the same direction as before, it is found passing South of Munsainee village and again at the Kossilla River. The point on the Kossilla where it is found is about 2½ miles above Duckalee ; it is obtained on the hill-sides on both banks of the river. Mines are now being dug to ascertain precisely the true character of the deposit there. The specimens obtained from the Western

bank of the river are heavy and resembles the best quality of the Beejapoor (Huldwanee) ore.

The point where the ore is found on the Kossilla is very convenient for the establishment of large works. Hackeries go much higher up, and the quantity of water power is very considerable.

The quantity of water in the Kitcheree River is also very considerable, where works would be erected. This point is about
 Kitcheree River. $2\frac{1}{2}$ miles from the iron bed near the Leeta Bunnee temples, where two streams join to form the Kitcheree. From works established at this point, the bed of iron ore would be very easily obtained down tramways laid from the mines, at any point from Ghutoorah to opposite Pât Kôt. Lime-stone is also obtainable in abundance, especially in the ravine close to Umharee.

The discovery of the continuity of the deposit of iron ore to the Westward may be regarded as exceedingly satisfactory, especially on the banks of the Kitcheree and the Kossilla Rivers; and although at many intermediate places, the bed has not been found cropping out, yet, wherever the contour of the Hills or the crossing of ravines has been found favorable to the exposure of the bed, there it has been found. Many of the points mentioned have only just been discovered, precise details cannot therefore be given.

Some excavations have been made at Latee Bullona, where the ferruginous quartz with iron ore has been discovered.
 Latee Bullona. The specimens obtained at a short distance below the surface are of a deep crimson color, resembling cinnabar, for which it might be easily mistaken. It maintains its character of being associated with quartz and is highly refractory, but may prove useful in mixing with the very fusible ores of the newer rocks.

The intermediate points to the Kossilla from Pât Kôt are now being carefully researched and also the banks of the Ramgunga.

The works at Dechouree are now making rapid progress. The arches of the furnace have been turned and the foundations
 Dechouree works. for the water-wheel dug and laid.

The making of fire-bricks also proceeds more satisfactorily than at first, the native workmen having become used to the material.

(Signed) W. SOWERBY,

IN CAMP ON THE KOSSILLA, }
 The 13th December 1855. }

Engineer in charge.

(Copy.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF WORK DONE AT DECHOUREE.

Dechouree, 10th December 1855.

DATE	Days of Week.	Carpenters.	Sawyers.	Blacksmiths.	Stone-masons.	Coolies.	Lime-burners.	Brick-makers.	Sawyers and Carpenters.	Tramway.	Road-makers.	REMARKS.
3rd,	Monday,	21	0	2	37	136	25	36	34	34	16	The arches of the furnace have been turned. The foundations of water-wheel are now being cut and laid out; the timber framing has been in great part fitted.
4th,	Tuesday,	21	2	2	37	130	25	36	34	34	16	
5th,	Wednesday,	21	4	2	37	130	25	36	34	34	16	
6th,	Thursday,	21	4	2	37	127	25	36	34	34	20	
7th,	Friday,	21	4	2	37	127	25	36	34	34	20	
8th,	Saturday,	21	4	2	37	127	25	36	34	34	20	

(27)

(Signed) REES DAVIES,

Superintendent.

(Signed) W. SOWERBY,

Engineer in charge.

(COPY.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF SURVEY, &c.

EMPLOYED during the greater part of the week in organizing the works at Dechouree, also in getting the jungle cleared, setting out and forming roads to works, quarrying stone, making bricks, &c. The roads have now been all cleared, or nearly so, and the old hackery track to Kaleedoongee is being opened out. Some difficulty has been experienced in obtaining laborers of a suitable kind, owing to the work being new and the men not accustomed to it : likewise in obtaining tools, which have to be brought from a distance (Moradabad or Rampoor.) Those requirements are however being now fast supplied by the Senior Assistant Commissioner.

The clearing of the jungle has been let by contract at suitable prices, under the advice of the Senior Assistant Commissioner.

A searching party has now proceeded to the Westward, and have sent in several specimens of inferior iron ore found about 2 miles to the Westward near the village of Shaat Ghudawa.

The ground is being opened at several new places ; the results are yet unknown, except at Beejapoor, where a large opening has been made into the iron bed about six chains on the upper side of the previous opening. The details will be given next week.

A path has been cut through the jungle under the directions of Lieutenant-Colonel Drummond from the high scar at the West end of Loha Bhur Bhur towards Bhoonka, and the result has been the exposure of the bed in large masses in three different places.

In the first place it is seen close to the bed of the Kora stream to a length of 150 feet and depth of about 10 feet. A few hundred yards farther on it is again seen to a length of about 150 to 200 feet and a thickness of about 10 or 12 feet. Those two places expose the bed on its longitudinal face. The bed appears undisturbed and *in situ* at a distance of about a quarter of a mile further on, and close to the Bhoonka bed the ore is again seen exposed transversely to a length of about 100 feet and to

a thickness of 20 feet (more or less,) a half dry stream passing at each side of the mass and leaving it quite exposed. No new excavations have been considered necessary here at present. The ore is a rich brown iron ore, similar to that found at Loha Bhur Bhur and of a metallic appearance when fractured. The finding out of those new beds is of very great importance, as it settles the question completely as to the character of the Loha Bhur Bhur deposits, proving their continuity beyond all doubt, and that they are not mere "pots" as has been suggested or supposed by one or two parties that have visited them.

(Signed) W. SOWERBY,
Engineer in charge.

DECHOUREE, }
The 20th November 1855. }

No. 172 OF 1856.

FROM

C. P. CARMICHAEL, ESQUIRE,
Asst. Secy. to Govt. of the N. W. Provinces,

TO

J. W. DALRYMPLE, ESQUIRE,
Offg. Secy. to Govt. of India,
Home Department.

Dated Agra, the 12th January 1856.

DEPARTMENT PUBLIC WORKS,
PUBLIC.

SIR,

IN continuation of Mr. Secretary Muir's letter, No. 2658 A., dated 26th December last, I am desired by the Hon'ble the Lieutenant-Governor to forward, for the information of the Most Noble the Governor General of India in Council, the accompanying copy of a Weekly Progress Report, ending December 15th, of the survey of the iron works in Kumaon by Mr. W. Sowerby, Engineer in charge.

I have the honor to be,

SIR,

Your most obedient servant,

C. P. CARMICHAEL,
Asst. Secy. to Govt., N. W. Provinces.

AGRA, }
The 12th January 1856. }

(COPY.)

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF SURVEY ENDING 15TH DECEMBER 1855.

THE District from Munsainee to the banks of the Kossilla has been again gone over, and the result is a most complete proof of the existence of an immense abundance of iron-stone. The Hills called the Ookulkee Doong Hills on their Southern slopes is literally full of iron-stone from the lowest valleys to the highest peaks. The bed *in situ* was noticed particularly in a ravine a little to the West of Choopra; also huge blocks of it in all the ravines and hill-sides, inspected right up to the Kossilla. The specimens obtained, however, is not of a very rich quality, but good useful iron-stone.

In the same Hills lime-stone has been found of a good quality.

Beyond the Kossilla, in the Dungar Nuddee, about one mile below Mohan, a bed of the same description of ore as that found at Beejapoor has been discovered. The bed is seen to a length of about 120 feet, and to a thickness of 20 feet, the floor of the bed not being seen at that depth. In the same locality, the white fire-clay has been found, and at a short distance lime-stone is found. Further up the Valley of the Kossilla, at Punealee Ghar, a heavy kind of ore is obtained. The bed is seen to a length of 100 feet and about 3 feet in thickness. In the Valley of the Kossilla a fine kind of loam is found, very suitable for foundry purposes.

Continuing along the road towards Ghurar, on the banks of the Ramgunga, a bed of iron-stone is seen in a half dry stream: it is about 2 feet 6 inches in thickness, and is seen on both sides of the stream for a considerable distance: it is in nearly horizontal strata and is not of a rich description, being the spotted iron-stone. This is about 3 miles from the Ramgunga. In the same stream, still nearer the Ramgunga, another outcrop is seen of the same kind of iron-stone. Close to the banks of the Ramgunga, about 300 yards below the village of Ghurar, there is an outcrop of the poorer description of yellow hydrated iron-stone of considerable thickness, and higher up, in a dry ravine, there is a bed of a better quality, also of some extent. It is of the description with pea-like nodules in the stone.

On the East bank of the Ramgunga, about one mile below the village of Ghurar, and near a ford across the river, a bed of very rich reddish

brown iron ore has just been discovered. It is similar and equal to the best description found at Loha Bhur Bhur, containing a high per-centage of iron. It is seen in large blocks on the hill-side for a distance measured down the slope of the Hill of 50 yards, and of considerable width, and the bed *in situ* is clearly seen, sticking up out of the surfaces. It is greatly covered with soil and detritus. The bed is also found on the opposite bank of the river, about a quarter of a mile further on; down the river the bed is again seen, but it is of a poorer quality.

Still further down the river, the white fire-clay is found, and indications of a richer description of iron ore, similar to the rich red iron ore of Dechouree. Lime-stone has not yet been discovered in this District: there are however indications of its being close at hand.

The forests in the Ramgunga and the Kossilla are, if possible, denser than to the Eastwards, and the timber is chiefly saul and other hard wood suitable for charcoal.

The true character of these iron deposits having now been well ascertained, it has not yet been considered necessary to make any excavations of a great extent. A more detailed and careful survey will be made on returning Eastwards.

The lower part of the Ramgunga is now being searched, the new hackery road is already constructed up to within 2 miles of where the best iron-stone has yet been found, and access to the mine is easy.

The banks of the Ganges are now being searched, which river
The Ganges. bounds the Province to the Westward.

(Signed) W. SOWERBY,
Engineer in charge.

IN CAMP ON THE RAMGUNGA, }
The 17th December 1855. }

The works at Dechouree having been visted by Captain Strachey, he
Dechouree Works. will be able to report progress.

(Signed) W. SOWERBY,

No. 995 OF 1856.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces,

TO

C. BEADON, ESQUIRE,
Secy. to the Govt. of India,
Home Department,
FORT WILLIAM.

Dated Agra, the 15th February 1856.

PUBLIC WORKS DEPARTMENT,
PUBLIC.

SIR,

I AM directed to forward, for submission to the Most Noble
the Governor General in Council,
the accompanying copy of a cor-
* Letter from, No. 52, dated 2nd February
1855, with enclosure and maps.
Letter to, of this date, No. 994.
respondence* held with the Offi-
ciating Commissioner of Kumaon, relative to Mr. Sowerby's general
Report on the iron deposits of Kumaon and Gurhwal.

I have the honor to be,

SIR,

Your most obedient Servant,

W. MUIR,

Secy. to Govt., N. W. Provinces.

AGRA,

The 15th February 1856.

(COPIES.)

No. 52 OF 1856.

FROM

CAPTAIN H. RAMSAY,
Offg. Commissioner of Kumaon,

TO

WILLIAM MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces.

Dated Kumaon, the 2nd February 1856.

SIR,

I HAVE the honor to forward Mr. Sowerby's Report on the
iron deposits examined by him during the course of a rapid survey of
the lower Hills, between Chukhata and the Ganges.

2. I have received a large box of specimen of ores from Mr. Sowerby, which pending your instruction I have retained in my Office.

I have the honor to be, &c.,

(Signed) H. RAMSAY,
Offg. Commissioner.

KUMAON COMMR.'S OFFICE, }
The 2nd February 1856. }

GENERAL SUMMARY OF THE PRELIMINARY SURVEY OF THE
IRON DEPOSITS IN THE LOWER HILLS OF KUMAON AND
GURHWAL FROM THE GOLAH RIVER TO THE GANGES.

DESCRIPTIVE DETAILS.

THE survey commenced at Beejapoor, about 2 miles to the East of the Golah River, where an excavation was made into the bed of iron ore, which exposed it to a thickness of about 50 feet, the ore being a red clay iron ore rather friable, and slightly metallic in appearance when fractured. Throughout the bed are interspersed flakes of white clay, and the under-lying strata is a bed of white fire-clay. About 400 yards beyond this opening, and in a direct line with the strike of the bed, the clearing of the jungle and under-wood exposed a high scar, in which the bed of iron ore is again seen out cropping to a thickness of about 40 feet. This is on the Eastern bank of the Teerra Nuddee (a small half dry stream.) The bed was covered with a great deal of surface soil, which has been partly cleared, and the specimens obtained from it are of a better quality than at the point where the opening was made, being heavier, more metallic, and more free from the flakes of white clay. The corresponding portion of the bed on the opposite side of the stream is but little exposed, being covered with huge boulders of sand-stone and surface soil. Lime-stone is obtainable within a short distance of this place. The Golah is a large stream.

At Muchear, Pepul Pokree, Punealee and Puttepoor—all in the neighbourhood of Chownsilla—narrow beds of inferior siliceous looking ore were found, the beds seldom exceeding 2 or 3 feet in thickness: also beds of white clay and rich red ferruginous clay. The Hills here recede considerably to the Northward. The streams in this locality were quite dry when visited.

From further explorations at Loha Bhur Bhur, it now becomes apparent that there are two distinct beds at that place. The Western part of the iron bed is a bed of hydrated brown iron-stone, and the Eastern part, where a portion was supposed to have slid down the Hill bodily, is in fact a lower bed of more compact brown iron-stone : the upper bed is again exposed at Derail Khera.

The intermediate space between Loha Bhur Bhur and Dechouree has been cleared of jungle, and the result has been the exposure of huge masses of rich compact brown iron-stone, and the bed *in situ* at several places to the Westward of the village of Bhoonka. The masses are seen for a distance of more than half a mile, some of these masses being many tons in weight ; they appear to be the outer edge of the bed broken up. Thence to Dechouree, a distance of about 2 miles, there is an interval where but few specimens have been obtained, and those of an inferior quality coming from narrow beds.

A shaft has been sunk at Dechouree in the broad open ravine to a depth of about 18 feet. The first 12 feet below the surface is a very compact and rich bed of iron-stone ; afterwards the bed becomes like that at Beejapoor, with flakes of white clay interspersed, and the white clay becomes more frequent, and the ore poorer as the shaft continues downward. Above the iron bed at Dechouree are alternate beds of white sand-stone, red ferruginous clay, white fire-clay, and interspersed in the sand-stone are very thin and short seams of lignitic coal. Above the white sand-stone, high up in the Hill, a bed of compact brown iron-stone is found ; it is exposed in large masses at the surface, the ore is exactly similar to the bed at Loha Bhur Bhur, and still higher up in the Hill, above this bed, other beds of inferior iron-stone are found. These latter beds are narrow and are in the yellow micaceous sand-stone formation. Higher up the Boer Nuddee several ferruginous beds are found ; they are chiefly however red friable clay-stones.

The specimens obtained from the Hills between the Boer Nuddee and Dechouree to the Dubka are chiefly of an inferior character, found in small blocks near the village of Shail and Gugaree. Coming from narrow beds, the Hills here retreat considerably to the Northward.

After crossing the Dubka Nuddee, near a village called Ghuttóorah, the iron-stone is seen a short distance up a half dry ravine, and from this point in a nearly North-westerly direction the bed is successively seen out-cropping, sometimes to a considerable thickness, and at other places only small blocks are seen on the surface. These out crops and blocks continue up to the ravine a little to the North of the village of Umraihee (Ghora Kôt,) where huge masses cover the hill-side, and near the same place in a dry ravine the bed *in situ* is seen to a thickness of about 20 feet.

From Umraihee to the Bamanee Nuddee (a tributary of the Kitcheree at the Eastern side of Pât Kôt,) blocks of the iron-stone are found in the numerous ravines and on the Hill slopes; and low down in the Bamanee Nuddee a bed is cut through and is seen *in situ* in the sand-stone. Owing to the dense jungle and surface soil the precise thickness could not be ascertained. The ore along the whole of this District is of the same character as at Loha Bhur Bhur, namely, a brown clay ore, heavy in the hand, and the fracture slightly metallic, sometimes very much so.

Lime-stone (tufa) is obtainable in this locality, a wall of it was noticed in the Kuddaree Nuddee, near Umraihee.

The Dubka River, at the upper part of it, might be sufficient to drive the machinery for a couple of blast furnaces.

The quantity of water in the Kitcheree River, near the Seeta Bunnee Temples, (where two streams meet,) would be ample all the year round to drive machinery for four blast furnaces. This point is about $2\frac{1}{2}$ miles South of the iron beds.

On the gently sloping cultivated ground, South of Pât Kôt, the ore is not found. The proper position of the deposit here would be considerably beneath the surface.

A little to the North of Pât Kôt, at a considerable elevation, there is a kind of ferruginous killas, with occasional small blocks of rich, but very refractory iron ore, but nothing like a bed or vein was come upon.

Beyond Pât Kôt Westward the Hills contain iron-stone, as indicated by blocks on the surface. This continues up to Bhora Kôt.

At Lahee Buleon there was found large masses of highly ferruginous quartz, with bits of rich iron-stone, sometimes of a bright red color, resembling cinnabar, for which mineral it might easily be mistaken. The quantity obtainable is very considerable, but it would be found refractory in the blast furnace; it may however become exceedingly useful for mixing with the more fusible ores. These masses of ferruginous quartz are found at a high elevation. Up the Kuttulea Nuddee, in the same locality, there was found beds of ferruginous killas.

Continuing in a North-westerly direction, iron-stone was found in the numerous ravines and hill-sides around Choopra, Munsainee and Mooluguree, right up to the Kossilla River. Beds were particularly noticed in a ravine a little to the West of Choopra and at Mooluguree. The Hills called Ookulkee doong Hills, on their Southern slopes, are literally full of iron-stone. The beds exposed belong to the upper series, and are not thick, seldom exceeding 2 feet in thickness, and the ore is not very rich, but good workable ore.

Lime-stone exists in the same locality. Beyond the Kossilla River to the West, at a distance of about half a mile from the river, and about one mile below the village of Mohan, in the Dungar Nuddee, (a dry stream,) a bed of rich red iron-stone is seen exposed for a length of about 120 feet and thickness of about 20 feet. The ore is a rich red clay iron-stone, precisely similar to that at Dechouree, with a small portion of white clay interspersed throughout the bed as at Beejapoor.

Iron-stone was also found near Punoadh, on the Kossilla, below Mohan. There was a great deal found lying in blocks on the surface.

At Chookum, above Mohan, on the Kossilla, a narrow bed of metallic-looking iron ore was found.

The white fire-clay is found in the Dungar Nuddee, near the iron bed.

Along the bed of the Kossilla River, an excellent loam, suitable for foundry purposes, was noticed.

Lime-stone (tufa) was also found in the same locality.

The water power of the Kossilla is very great.

Following the road to Ghurrai (on the Ramgunga River) beds of red ferruginous clay and white clay are exposed, especially just beyond the Dungan Nuddee; and in a half dry ravine a bed of the poorer kind of iron-stone is seen for a considerable distance: it is about 2 feet 6 inches in thickness at the out-crop, the strata being nearly horizontal: this is about 3 miles East of the Ramgunga; and in the same stream, still nearer to the Ramgunga, other beds are seen out-cropping of the same kind of iron-stone.

Close to the village of Ghurrai, at the edge of the River Ramgunga, there is a bed of very poor yellow clay iron-stone, but it appears to be of considerable thickness.

A little to the North of the village of Ghurrai, high up in a dry ravine, there is to be seen a bed of iron-stone, about 4 feet in thickness.

On the East side of the Ramgunga, and near a ford in the river, 2 miles below Ghurrai there is a bed of rich reddish brown iron-stone, similar to that of Loha Bhur Bhur. Large blocks are visible on the hill-side, nearly down to the water's edge, over a distance of about 200 feet, and the bed *in situ* is seen sticking up at the surface. It is greatly covered with surface soil; the bed is also found on the opposite side of the river. About a quarter of a mile further down the road the same (or another) bed is again seen, but of rather poorer quality.

About one mile further down, in a ravine to the East of the Ramgunga, beds of white fire-clay are found; also the beds of highly ferruginous red clay, similar to the beds overlying the iron ore at Dechouree.

Lime-stone is obtainable in this locality. From the village of Ghurrai, the Ramgunga runs in a nearly North-westerly direction; the Hill slopes and ravines on the Northern side of the river are full of iron-stone; but on the Southern side of the river there are no indications whatever of iron-stone, from a point 5 or 6 miles below Ghurrai to opposite Boxsur (a timber-cutting station).

Crossing the Ramgunga, about half a mile above Boxsur, on the new road to Choulcherree, (a timber-cutting station,) about half a mile beyond the river and about a quarter of a mile from the village of Simulkurree, the brown iron-stone is seen in

masses on the hill-side, along which the road passes. The walls of the road are partly built of it, the distance over which the blocks are seen is considerable and appear to be lying in a line about North-west and South-east.

About 2 miles further on the same road, beyond the Hill over which it passes, in a half dry ravine to the North of the road, a bed of compact brown iron-stone is distinctly visible to a thickness of about 30 feet: the ravine in which it is found is a branch from the Pulaen, down which access to the Ramgunga is easy.

Further on the same road, about one mile, blocks of brown iron-stone are visible, and were being dug up to make the new road. The bed *in situ* is exposed in an adjacent ravine.

Still further on, in the Mullanee Sot, a narrow bed *in situ* is exposed, and large masses in the bed of the river. This Mullanee. ravine is the route which the proposed new road from Choulcherree to Boxsur is to take for bringing down timber.

Beyond the Sumareea or Pulaen Nuddee, which passes close by Choulcherree, the surrounding Hills are full of iron-stone. A bed *in situ* was noticed in a dry ravine; Choulcherree. it was about 3 feet in thickness, and masses on the hill-sides.

The water power in the Pulaen Nuddee would probably be sufficient for two blast furnaces, during the greater part Pulaen River. of the year.

The road from Choulcherree to Kotree, on the Sona Nuddee, takes a very circuitous route, and passes through the centre Choulcherree to Kotree. of the Patlee Doon. On this road beds of iron-stone are seen exposed *in situ* in the sand-stone formation, and masses on the surface are come upon at almost every step, the masses sometimes continuing for upwards of a mile, the ore being a good workable iron-stone, sometimes exceedingly heavy in the hand and rich: this continues quite up to the Sona Nuddee.

The Hills around Kotree are also full of iron-stone. Masses, many tons' in weight, are found lying on the surface on the Kotree. hill-sides and in the ravines: this is especially the case near the village of Kharee, where masses were seen lying on the surface for a length of about 200 feet and a width of 90 feet: also in the corresponding Hills, West of the Sona Nuddee, similar masses were observed.

The Sona Nuddee contains but little water at the dry season of the year, probably just sufficient to drive a small wheel for one blast furnace.

Sona Nuddee
Water Power.

At Kotdwara, on the Koh Nuddee, several beds of brown iron-stone are visible in the sand-stone formation, and blocks of it are found lying on the hill-sides, especially at a point about a quarter of a mile above the village. On the road-side to Seerinugger, beds of white fire-clay are also seen exposed in the high banks of the river close to the village; also red ferruginous clay.

Kotdwara.

About a mile beyond Kotdwara to the Westward, up a ravine at present dry, in a high scar, a bed of compact rich brown iron-stone exists—it is about 3 feet in thickness at the outcrop, and is exposed for a distance of upwards of 150 to 200 feet. Masses of it are found lying in the bed of the stream. About 50 feet above this bed, in the same scar, there is another bed of a reddish brown iron-stone, rather poorer in quality, but good workable ore—it is about 4 feet in thickness. In the same ravine the white fire-clay and the red clay beds are also found.

Lime-stone.

Lime-stone (tufa) is obtainable at some little distance further into the Hills.

The water power of the Koh Nuddee would be ample at all times of the year for driving machinery for two blast furnaces, and the high banks on each side of the river are well suited for sites for the furnaces.

Water power of the
Koh Nuddee.

From Kotdwara to Lol Dâk, iron-stone, of an inferior kind, has been found in almost every ravine crossed, coming from narrow beds in the sand-stone : the whole of these ravines are dry, or nearly so.

Around Lol Dâk, beds of a good workable iron-stone were found, also red ferruginous clay beds and white fire-clay by the side of the Rowason Nuddee.

Lol Dâk.

The water power of the Rowason Nuddee would probably be sufficient for one or two blast furnaces during a greater part of the year.

The water power of the
Rowason.

In the Mittewallee Nuddee (which is half dry) to the West of Lol Dâk, there is a bed of red clay, and beyond this the Hills appear to contain a great quantity of iron-stone, as indicated by blocks on the hill-sides and in the ravines.

Mittewallee Nuddee.

The Hills to the North of the village of Mundil (6 or 7 miles from the Ganges) were found to contain iron-stone, but chiefly of an inferior character. The ravines were full of large blocks coming from the upper narrow beds, and in a ravine about 2 miles from the Ganges, West of Mundil, blocks of iron-stone were found in abundance, not very rich, but a serviceable iron-stone. Occasional bits were very rich and heavy. Following this ravine high up in the Hill, three distinct beds were come upon of a thickness varying from 1 foot 6 inches to 2 feet 6 inches : they were exposed only for a short distance.

In this locality the white sand-stone was found ; also the red clay beds indicative of a richer description of iron ore, but no rich bed was found actually exposed.

A little above Ghoree Ghât on the Ganges, a small stream empties itself into the river, coming from the neighbourhood of the village of Tal. Proceeding up this stream for about 2 miles, the Hills on each side become steep and precipitous, the formation being a compact clay-slate, in which are found beds of ferruginous killas and alum shales. In a dry ravine running up the hill-side, on the Northern bank of the stream, masses of very heavy rich red iron-stone were found for a distance of about 300 feet measured up the Hill slope. One mass amongst many was found, weighing about 200 lbs., and contained about 70 per cent. of metallic iron : it was forwarded to the Roorkee Works. This kind of iron ore is usually found in veins in the older formations, and judging from the masses on the surface, these veins must be of very considerable thickness, but owing to the immense amount of detritus on the hill-side, no veins were visible. The removal of this surface soil and detritus will be a work of considerable labour, and the subsequent mining of the ore very difficult and expensive. The ore is also refractory.

The ferruginous killas contains but a small per-centage of iron, and would not be worth smelting alone, but might become useful for mixing. The beds are of considerable thickness.

Several other beds of a ferruginous character were also found up this stream, but no bed of iron ore.

Lime-stone. Lime-stone in masses were also found in the same stream.

In this ravine were also found several veins of carbonaceous shale (or Carbonaceous shale in mineral block,) a portion of which was mined, and Tal Nuddee, it appeared to be continuous. It is mixed up with crystals of alum, sulphur, white pyrites, and other impurities, and is of little or trifling value. It is found in great abundance in all parts of the world. The only use made of it is the manufacture of an inferior kind of black lead, which it resembles.

Lower down the Ganges, near to Jumnea Bagh, small pieces of rich iron-stone were picked up, and the Hills on the Jumnea Bagh. Southern side of the stream were searched without success. There was found a bed of inferior white fire-clay, and the red ferruginous clay, but the Hills did not appear to be a character to yield iron ore.

Lower down, near to Hurdwar, the Hills contain ferruginous beds, Hurdwar. which might be suitable for mixing with rich ores, but too poor to be properly called iron-stone.

The existence of iron-stone has been ascertained in the Dehra Doon, Dehra Doon. but no portion of it was included in the present survey.

Returning to the Eastward from Kotdwara to Khalagurh, the lower Kotdwara to Khala- Hills adjacent to the Plains were found full of gurh on the Ramgunga. iron-stone, chiefly of a good workable description; masses of it were found lying on the hill-sides and in all the ravines, more especially at a point along the road, about half a mile to the Westward of the village of Dohulcund, where Dohulcund. huge blocks of heavy brown iron-stone are to be seen lying on the hill-side, the Hill being apparently a hill of iron-stone. This point is about 6 or 7 miles West of the Ramgunga. In this neighborhood there is also plenty of white fire-clay and the red ferruginous clay beds; also lime-stone.

In the neighbourhood of Khalagurh, where the Ramgunga enters the Khalagurh. Plains, narrow beds of inferior brown iron-stone were found, the greatest thickness of any bed not exceeding 2 feet, nor does there exist any indication of better beds below the surface.

From the Ramgunga up to the village of Berana to the Eastward, the Berana. lower Hills are full of iron-stone of the inferior brown kind, as indicated by blocks of it on the surface.

Up the Berana Sot, at a distance of about 3 miles, large masses of brown iron-stone are found in the bed of the stream; they are of good quality and apparently coming from a bed of no inconsiderable thickness. The precise position of the bed and its thickness could not be readily ascertained.

Along the road to Lal Jhung Eastward, the hill-sides and ravines were found to be full of the inferior brown iron-stone, and a short distance up the Sot, at Lal Jhung, a narrow bed was noticed, the specimens obtained from it not being rich. Here were also found white and red clay beds.

A little beyond Lal Jhung, on the hill-sides, masses of iron-stone of a good workable quality were found apparently coming from a bed of some thickness: these blocks were observed to be continuous for a distance of about 2 or 3 miles nearly up to the village of Dehla.

Up the Sot, at Dehla, a bed *in situ* was seen of about 2 feet in thickness. In a high scar on the East side of the stream, near the village, the bed is exposed for some distance, but it appears to be a good deal disturbed and broken up.

Beyond Dehla Got small blocks of common brown iron-stone were found for a distance of 2 or 3 miles towards Ramnuggur. Approaching that place the Hills become low and no indications of iron-stone were found.

The District from Ramnuggur to Dechouree is a series of low undulating hills and doons, sections of which, to a good depth and length, are seen in crossing the Kossilla, the Kitcheree and the Dubka Rivers. The sections seen are chiefly alternate strata of gravel, with rounded boulders, beds of soft red sand-stone, and a hard conglomerate of lime, gravel, and boulders; the beds lying nearly horizontal. There are few or no indications of iron-stone in this District, nor up the Kossilla as far as Duckoollee.

GENERAL REMARKS ON THE IRON DEPOSITS.

The true character and disposition of these beds have now been pretty well ascertained; they belong to a class of ores, the mineralogical term for which is limonite, embracing the lower red clay ores, approaching the character of a hematite; the other beds being compact brown iron ore, hydrated brown iron ore, and the upper and narrower beds being of the character of bog ores, originally formed

under water, and subsequently upheaved into their present elevated position. The ores from the upper beds are frequently cellular, and the narrower beds are chiefly formed of nodules of iron, mixed up clay a small proportion of lime and silicious matter—they also sometimes contain small flakes of mica. The lower beds of red ore frequently are found to have flakes of the adjacent white clay interspersed through them.

The lower beds are of unexceptionable quality, containing a high percentage of metallic iron; the upper narrow beds
 Quality of beds. will be found valuable for reducing the richer beds; and what renders them more suitable for this purpose is that they contain a large proportion of lime. The red ferruginous clays will also be found valuable for mixing with the richer ores, the latter being generally too rich to be smelted alone.

The mining of the ore from the lower beds will be found exceedingly
 Working of the beds. easy, being generally so near the surface and frequently quite above it. The narrow beds are in a compact micaceous sand-stone, and will be rather difficult and expensive to work.

These ores are precisely similar to the valuable deposits so expensively worked in many parts of Europe and in
 Comparative character of the beds. the United States of America, and they are also of the same character as the ores found in the extensive mineral fields of South Africa recently investigated by myself, where they are found overlying a valuable coal deposit.

Commencing at Beejapoor to the Eastward, the lower bed of red iron
 General disposition of beds. ore is exposed; it is again seen at Dechouree and near Mohan on the Kossilla, beyond which point to the Westward it is nowhere seen actually exposed. The thick beds of brown iron-stone are however well developed at many points along the whole of the lower Hills. These beds of brown iron-stone are but little seen beyond Kotdwara, where they are however well developed.

From this it would appear that there had been a general upheaval of the beds by a disturbing force coming from the direction of South-east and following a North-westerly course, the disturbing force gradually becoming less powerful as it continued Westward, or what would produce nearly the same phenomena, there may be a general inclination of the country at the foot of the Hills towards the Eastward. This view is

supported by the researches of Lieutenant-Colonel Drummond to the East of the Golah, where the beds become richer, more compact and better developed than at any point to the Westward.

The accompanying longitudinal section will give a general idea of the disposition of the beds. The section is merely assumed, having no instruments to ascertain their relative elevations, and the maps of the Districts are generally very inaccurate. The beds are shown horizontal, in all likelihood they will be found to be undulating.

Section No. 2. shows the position of the beds with reference to the higher ranges. The general dip of the beds is about one point East of North, at an angle from 15° to 45° .

The supply of iron-stone along these lower ranges is so great, that it would be utterly impossible to give any approximate calculations. An idea of the size of the beds will be best formed by comparing them with the vast mountain range of which they form a part. If works are established on ever so large a scale, they would, in the course of ages, produce but a feeble impression on the beds.

The whole of the deposits are quite accessible by means of waggons ; tramways would make them still more so. The only limit then to the production of iron is the supply of fuel. The forests along the whole Province are as dense as possible, in fact nearly in a state of nature which, in a nearly tropical climate, is something very great. They are uncut, except in a few places, and they extend as low down as Ramnuggur on the Kossilla, Khalagurh on the Ramgunga, and below Jumnea Bagh on the Ganges. The greater part of the timber is of a quality most suitable for making charcoal, much of it being saul and other hard wood. There is a good deal of timber, which is not so suitable for making charcoal, but would be of value for supplying steam power to work the blast furnaces, where water power was deficient.

The establishment of a few blast furnaces in the neighbourhood of the timber-cutting stations would use up the fuel cut from the trees, the branches being of no value as timber, but excellent for charcoal.

Taking the quantity of timber in these forests at a low calculation, and assuming that it is re-produced in ten years, the forest would supply sufficient fuel to keep

200 blast furnaces at work, each producing at the rate of three tons per day. The total annual supply of iron would be upwards of 2,00,000 tons, the area to supply this being taken at 100 miles in length and 10 miles in width, or 1,000 square miles.

The following list of specimens and localities will give a comprehensive idea of the number of beds and their relative value.

(Signed) W. SOWERBY,
Engineer in charge.

DECHOUREE, }
The 30th January 1856. }

BHABUR IRON ORES.
LIST OF SPECIMENS, WITH REMARKS.

	No.	Locality.	REMARKS.
GOLAH.	1	Beejapoor,	Heavy and rich.
	2	Ditto,	Tufaceous lime-stone.
	3	Pepul Pokree,	Workable, 2 feet bed.
	4	Muchear,	3 feet bed, clayey and poor, good for mixing.
	5	Punealee,	Micaceous, sandy and poor.
	6	Ditto,	Bog ore, workable.
	7	Chownsilla,	Narrow bed, poor, but workable.
BOER.	8	Bhoomka,	Good ore, very serviceable.
	9	Ditto,	Poor, but serviceable.
	10	Dechouree,	Bottom of shaft 20 feet deep.
	10 A	Ditto,	12 feet below surface green clay.
	11	Ditto,	From blocks on surface very rich.
	12	Ditto,	Ditto ditto, rich.
	13	Ditto,	Ditto, calcined.
	14	Ditto,	White sand-stone.
	15	Ditto,	Red ferruginous clay, useful for reducing.
	16	Ditto,	White fire-clay, requires well preparing.
	17	Ditto,	High up in the hill, good ore.
	18	Ditto,	Ditto ditto, hydrated ditto.
	19	Ditto,	Ditto, poor bog ore.
	20	Ditto,	Clayey slate, with stains of iron.
	21	Ditto,	Lime-stone from Dechouree, good.
DUBKA.	22	Shait,	Surface, specimen poor.
	23	Gugaree,	Ditto, ditto very poor.
	24	Ghutoorah,	Workable ore, very fair.
	25	Ditto,	Clayey, workable.
KITCHEREE.	26	Umrilhae,	Good workable ore.
	27	Ditto,	Ditto ditto.
	28	Ditto,	Ditto ditto.
	29	Ditto,	Poor, but workable.
	30	Pât Kôt,	Ferruginous quartz, refractory.
	31	Ditto,	Refractory.
	32	Bhora Kôt,	Ditto, { Quartz.
	33	Ditto,	Ditto, {
KOSSILLA.	34	Ghaitee Pahar,	Poor, but workable.
	35	Choopra,	Ditto, ditto ditto.
	36	Moola Gharee,	Ditto, ditto, much on surface.
	37	Dungar Nuddee, .. .	Heavy rich red iron ore.
	38	Ditto,	White clay interspersed.
	39	Panoad,	Poor, much on surface.
	40	Chookam,	Workable small bed.
	41	Choopra,	Lime-stone, tufaceous.
	42	Kossilla,	Ditto ditto.
RAMGUNG.	43	Ghurra,	4 feet bed, poor but workable.
	44	Ramgunga,	Small bed, poor.
	45	Ditto,	Ditto ditto.
	46	Ditto,	Below Ghurra good workable ore.
	47	Ditto,	Lime-stone tufaceous — M. Ghurrar.
	48	Boxsur,	Fair, workable, much on surface.

	No.	Locality.	REMARKS.
RANGUNGA.	49	Patlee Doon,	Workable,
	50	Ditto,	Poor, workable,
	51	Ditto,	Very ditto,
	52	Ditto,	Poor, workable,
	53	Ditto,	Ditto ditto,
	54	Ditto,	Ditto ditto,
PALAEN.	55	Choulcherree,	A kind of bog ore, poor.
	56	Ditto,	Heavy, rich.
SONA.	57	Karee,	Much on surface, good, workable.
	58	Ditto,	Ditto heavy, workable.
	59	Kotree,	Refractory, but workable.
	60	Ditto,	Workable.
KOEL.	61	Kotdwara,	Very serviceable iron-stone.
ROWASON KOT.	62	Kotdwara,	Very excellent, serviceable ore.
	63	Ditto,	White fire-clay, good.
	64	Ditto,	Workable, but poor.
	65	Lol Dāk,	3 feet bed, poor.
	66	Ditto,	2 feet ditto, ditto.
	67	Ditto,	Ditto ditto.
	68	Ditto,	Poor, 2 feet 6 inches.
GANGES.	69	Mundil,	Poor, small bed, contains lime.
	70	Ditto,	Ditto ditto ditto.
	71	Jumnea Bagh,	A kind of bog ore, rich specimen.
	72	Ditto,	Heavy and rich, but refractory.
	73	Ditto,	Ditto, but not rich.
	74	Tal Nuddee,	Poor and refractory.
	75	Ditto,	Ditto ditto.
	76	Ditto,	Rich, heavy and refractory, broken from the large mass sent to Roorkee.
	77	Ditto,	Rich, but refractory.
	78	Ditto,	Killas, poor.
	79	Ditto,	Carbonaceous shale impure.
	80	Ditto,	Ditto very impure.
	81	Ditto,	Lime-stone tufaceous.
	82	Kotdwara,	Lignitic coal.
RAMGUNGA.	83	Dohuleund,	Good workable ore.
	84	Ditto,	Workable ore.
	85	Khalagurh,	Poor.
	86	Lol Jhung,	Workable iron-stone.
	87	Dehla,	Ditto ditto.

(Signed) W. SOWERBY,

Engineer in charge.

DECHOUREE, }
The 30th January 1856. }

No. 994 of 1856.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces,

TO

• CAPTAIN H. RAMSAY,
Offg. Commissioner of Kumaon.

Dated Agra, the 15th February 1856.

PUBLIC WORKS DEPARTMENT.

SIR,

I HAVE the honor to acknowledge the receipt of your letter, dated the 2nd instant, No. 2, submitting Mr. Sowerby's general summary of the preliminary survey of the iron deposits in the lower Hills of Kumaon and Gurhwal, from the Golah River to the Ganges, and stating that you have received, and retained in your Office, a box of specimen ores from that gentleman.

2. In reply I am directed to intimate that the Lieutenant-Governor will have pleasure in submitting this satisfactory General Report for the perusal of the Supreme Government.

3. You are requested to take early measures for forwarding the box of specimen ores by bullock train from the nearest convenient point to Calcutta, to the address of the Secretary to the Government of India in the Home Department. The words "Specimen Ores from the Bhabur Iron Field from Mr. Sowerby," should be carefully cut, or printed, on the upper cover of the box, and you will have the goodness to send direct advice of the date of despatch of the box by the bullock train to the Under-Secretary in the Home Department.

I have the honor to be, &c.,

(Signed) W. MUIR,

Secy. to Govt., N. W. P.

AGRA, }

The 15th February 1856. }

No. 1132 OF 1856.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to Govt. of the N. W. Provinces,

TO

THE SECY. TO THE GOVT. OF INDIA,
Home Department,
FORT WILLIAM.

Dated Agra, the 20th February 1856.

PUBLIC WORKS DEPARTMENT.

SIR,

IN continuation of my letter No. 995, dated 15th instant, transmitting Mr. Sowerby's General Report on the iron deposits of Kumaon and Gurlwal, I am directed to forward, for submission to the Most Noble the Governor General in Council, the accompanying copy of an Appendix to that Report since received.

I have the honor to be,

SIR,

Your most obedient servant,

W. MUIR,

Secy to Govt., N. W. P.

AGRA,

The 20th February 1856. }

IN LETTER NO. 1132 OF 1856.

(COPY.)

APPENDIX TO THE GENERAL SUMMARY OF THE SURVEY OF THE IRON
DEPOSITS IN THE BHABUR OR LOWER HILLS OF KUMAON AND
GURHWAL.

Explanatory Notes to Section No. 1.

THE beds appear to alternate in the following order, with but little
variation, throughout the entire range. Some
Disposition of the beds. minute divisions are necessarily omitted.

Lowest beds seen.

1st. White fire-clay.

2nd. Red clay iron ore.

3rd. White sand-stone.

4th. White fire-clay (inferior.)

- 5th. Red ferruginous clay.
- 6th. White sand-stone, with thin seams of lignitic coal.
- 7th. Compact brown iron ore.
- 8th. Yellow micaceous sand-stone.
- 9th. Hydrated brown iron-stone.
- 10th. Sand-stone.
- 11th. Inferior hydrated sandy iron-stone.
- 12th. Sand-stone.
- 13th. Bog iron-stone (upheaved.)
- 14th. Sand-stone.
- 15th. Very poor boggy iron-stone.
- 16th. Sand-stone.
- 17th. Ferruginous sandy narrow seams.
- 18th. Sand-stone, with occasional bit of lignite.

The richer beds being the lowest are found close to the Plains, where the hills recede to the North for any considerable distance. The lower beds are not exposed, or may have been so, and subsequently denuded; this is especially the case in the valleys of the larger streams and the nearly horizontal beds of soft red sand-stone; gravel boulder beds and conglomerate are found running a long way up the valleys to the foot of the higher Hills.

Between Kotdwara and Ramnuggur, there is a sub-range of Hills, the lowest beds exposed being the red and white clays and white sand-stones. This sub-range of Hills resembles in every respect the Upper Bhabur range in its formation, and requires no separate section to illustrate it.

Notes on Section No. 2.

This section gives a general idea of the position of the iron deposits with reference to the higher Hills. It is assumed as being a section from the Ganges range to the Plains, being the point where the whole of the beds are well developed.

The lower Hills appear to have been formed by a succession of deposits and upheavals, the greatest upheaval being at their outer edge, near the Plains, where the upheaving force would naturally meet with the least amount of mechanical resistance, and they have therefore a uniform dip towards the Hills, giving the beds the appearance of underlying the older rocks of the higher ranges, whereas they overlie them.

The precise geological period to which the Hills belong, in the absence of any fossil remains, it is not pretended to determine. This is however a matter of secondary importance in a practical point of view.

A more minute examination of these Hills might in all probability modify this section in many respects.

(Signed) W. SOWERBY,
Civil Engineer in charge.

DECHOUREE, }
The 2nd February 1856. }

(COPY.)

No. 10.

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT OF SURVEY, &C., FOR THE WEEK ENDING
12TH JANUARY 1856.

IN searching for iron-stone in the immediate neighbourhood of Khalagurh, the only kind found are narrow beds of a poor description in the sand-stone formation. The greatest thickness of any bed seen is not more than 2 feet.

The Ramgunga to Khalagurh.
From Khalagurh to Berana, the hill-sides and ravines are full of iron-stone of the inferior brown kind, as indicated by blocks of it found on the surface.

Following up the Berana Sot for a distance of about 3 miles, there is, in a branch ravine, called the Peepul Sot, large masses of brown iron-stone of a good useful kind. They are found in the ravine and on the slope of the Hill, for a short distance, coming apparently from a bed of no inconsiderable thickness. The precise position and thickness of the bed was not however very distinctly visible.

Along the road to Lal Jhung, specimens were obtained, and a bed of the same kind of ore was found in the sand-stone, a little way up the Sot at Lal Jhung. The thickness of the bed did not appear to be more than 6 inches at the out-crop, and the specimens obtained were not rich.

A little distance beyond Lal Jhung masses of iron-stone of a good workable quality were found apparently coming from a bed close at hand, and of some thickness :

Lal Jhung to Dehla Sot.

these blocks were observed to be continuous nearly up to the village of Dehla, a distance of about 3 miles.

Up the Dehla Sot, a bed *in situ* was noticed of about 2 feet in thickness, situate in a high scar on the East side of the Nuddee, and a very short distance from the village [there is a small supply of water only in this Nuddee] the bed was seen for some distance, probably 100 feet, but it appeared to be a good deal disturbed and broken up.

Beyond Dehla Sot towards Ramnuggur, small blocks of common brown iron-stone were noticed for a distance of 2 or 3 miles. Approaching Ramnuggur the Hills become low and kutchia, and no indications of iron-stone were found in them. The preliminary survey to the Westward has now been so far made as to prove the existence of a large supply of workable iron-stone through the entire distance examined, embracing an area of about 1,000 square miles. More detailed information is still considered requisite, and the necessary arrangements have been made for procuring it.

Attention will now also be forthwith directed to the examination of the country to the Eastward in the direction of Burmdeo, already explored by Lieutenant-Colonel Drummond.

The clearing of the jungle in the neighbourhood of Dechouree and Lohia Bhur Bhur has exposed to a still further extent the iron deposits. After leaving Dechouree to the Eastward, there is an interval of probably 2 miles, where the iron-stone is less frequently seen, and the specimens obtained are poor; but beyond this to the Eastward, huge masses, many tons in weight, are again seen exposed on the hill-side, for a considerable distance; the ore being of a heavy rich description of brown iron ore. These masses are seen continuous nearly up to the village of Bhoomka, where the existence of iron-stone has been mentioned in a former Report. The true character of those deposits having now been well and clearly ascertained, and the almost certain probability of finding the ore all along the lower Hills renders the further clearing of the jungle for the mere purpose of searching no longer necessary. The clearing of the jungle above Dechouree, on the opposite side of the river, has exposed a wall of limestone [tufa] of considerable extent. A shaft is now being sunk at De-

chouree to ascertain exactly to what depth the bed of iron-stone goes and what underlies it.

The smelting furnace is now built up to the top, and the lining with fire-bricks is nearly complete. The length of time Dechouree experimental works. absolutely necessary for preparing and burning fire-bricks has been found so great, that the smelter, Mr. Davies, has in his anxiety to get the work completed used unburnt fire-bricks, which will have to be burnt in their place inside the furnace. This is a somewhat uncertain experiment, and may lead to a failure, unless very great care is taken. It however shows the absolute necessity for making early preparations this year for the intended operations of next working season, otherwise there is likely to result only a succession of failures.

Water-wheel. The water-wheel is far advanced, but is not yet fixed in its place.

Charcoal. A stock of charcoal is now being prepared.

The necessity for bunding the river, and forming reservoirs, has been carefully considered, and there appears to be several places where large reservoirs might be formed, the soil being, it is thought, sufficiently retentive, and would doubtless become more so every year. The present furnace is not however placed in such a position as to derive any advantage from these reservoirs if formed. The flow of water in the river still continues ample, and appears likely to remain so, as there has been no rain to keep up the flow of water, and it has not decreased. Attention will be immediately directed to form a temporary bund at the head of the channel, which has to supply the water-wheel. The plan recommended by Lieutenant Grcathed, of the Engineers, is not believed to be the best, and is unsuitable, except for very temporary works.

The tramway. The proposed short tramway has been curtailed at the suggestion of Captain R. Strachey, of the Engineers.

(Signed) W. SOWERBY,
Civil Engineer in charge.

DECHOUREE, }
The 15th January 1856. }

No. 679 OF 1856.

DEPARTMENT OF PUBLIC WORKS,
PUBLIC.

ORDER.—Ordered that a copy of the above be forwarded to the Secretary to the Government of India, Home Department, for information.

C. P. CARMICHAEL,
Asst. Secy. to Govt., N. W. P.

AGRA, }
The 1st February 1856. }

No. 1552 OF 1856.

FROM

MAJOR G. W. WILLIAMS,
Offg. Assist. Secy. to Govt., N. W. P., Agra.

TO

CECIL BEADON, ESQUIRE,
*Secy. to the Govt. of India,
Home Department.*

Dated Agra, the 7th March, 1856.

DEPARTMENT OF PUBLIC WORKS,
GENERAL.

SIR,

IN continuation of my letter No. 1132, dated the 20th ultimo, I am desired to forward, for the information of the Most Noble the Governor General in Council, the accompanying copy of a letter from the Officiating Commissioner of Kumaon, No. 78, dated the 22nd ultimo, forwarding Mr. Sowerby's Report on the iron works in Kumaon for the week ending February 9th.

I have the honor to be,

SIR,

Your most obedient servant,
G. W. WILLIAMS, *Major,*
Offg. Asst. Secy. to Govt., N. W. P.

AGRA, }
The 7th March 1856. }

(COPIES.)

No. 78 OF 1856.

FROM

THE OFFICIATING COMMISSIONER OF KUMAON,

TO

THE SECY. TO THE GOVT. OF THE N. W. P.,

Agra.

Dated Kumaon, the 22nd February 1856.

DEPARTMENT OF PUBLIC WORKS,

GENERAL.

SIR,

I HAVE the honor to forward Mr. Sowerby's Weekly Progress Report ending 9th instant.

I have, &c.,

(Signed)

H. RAMSAY,

Officiating Commissioner.

KUMAON ;
Commissioner's Office, }
The 22nd February 1856. }

No. 14.

HIMALAYAN IRON WORKS, KUMAON.

WEEKLY PROGRESS REPORT FOR THE WEEK ENDING 9TH FEBRUARY 1856.

THE work about the water-wheel is now nearly completed; the
Dechouree works. blast pipes, which are of wood, have been made,
and are ready for fixing. The blowing cylinders,
also of wood, are now being fixed in their place.

The charcoal-burning for the present experiment will be termi-
nated in the course of another week, when suffi-
cient will have been prepared.
Charcoal.

The bunding up of the river is now complete, so as to bring the
whole of the water in the river down the old
The bund. water-course, which has been put in a state of
repairs so far as it is practicable.

The two mines at Dechouree, namely, a shaft and drift, have been
continued, the former to a depth of 25 feet and the
The mines at Dechou- latter to a length of 23 feet. The object of the
ree.

shaft is to ascertain whether coal exists below the beds of iron ore. The drift is intimated to ascertain the distance the lower bed of iron ore continues into the Hill.

Openings into the ground to the Westward were directed to be made by an experienced native miner, and the result is that at Berana the bed appears to be about 4 feet thick. At Dohulcund it is ascertained to be 10 feet thick and very good workable ore. At Kotdwara the lower bed of rich iron ore has been come upon ; it is of very good quality, similar to the beds at Beejapoor, Dechouree and Dungar Nuddee on the Kossilla ; it is about 10 or 12 feet thick at the outcrop. This latter discovery is important, as it confirms the opinion expressed in the general Report, as to the existence of the lower beds further to the Westward than had at that time been actually ascertained.

(Signed) W. SOWERBY,
Civil Engineer in charge.

DECHOUREE, }
The 12th February 1856. }

REPORT,

By MR. BARRATT,

OF THE SURVEY OF THE

MINERAL DEPOSITS IN KUMAON.

No. 2030 of 1856.

No. 19.

FROM

W. MUIR, ESQUIRE,

Secy. to Govt., N. W. Provinces,

TO

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India,

Home Department.

Dated Agra, the 29th March 1856.

PUBLIC WORKS DEPARTMENT.

SIR,

I AM desired by His Honor the Lieutenant-Governor to transmit a copy of the papers noted in the margin, relating to the metalliferous deposits in Kumaon, and to recommend for the consideration of the Right Hon'ble the Governor General in Council, that the Report be printed for general information.

Letter from Commissioner,
Kumaon, No. 90, dated 29th
February 1856, with enclosures.

2. The Lieutenant-Governor is well satisfied with the manner in which Messrs. Barratt and Gray have conducted these inquiries. But he does not think it necessary that Officers of their class should be retained in Kumaon, with a view only to the assistance or instruction of the Native miners, who are men without capital or enterprise. The employment of Messrs. Barratt and Gray need not, therefore, be continued under the Government of the North-Western Provinces.

I have the honor to be, &c.,

(Signed) W. MUIR,

Secy. to Govt. N. W. Provinces.

AGRA,

The 29th March 1856.

(COPY.)

No. 90.

No. 20.

FROM

CAPTAIN H. RAMSAY,

Commissioner, Kumaon Division,

To

W. MUIR, ESQUIRE,

Secy. to Govt., N. W. Provinces.

PUBLIC WORKS DEPARTMENT.

SIR,

HIS Honor the Lieutenant-Governor is already aware, I believe, that Mr. Barratt was instructed by my predecessor to examine several mines in Kumaon and Gurhwal, which had not been visited by Mr. Henwood; I have now the honor to forward Mr. Barratt's Report which gives a clear and business-like description of all the mines he visited in company with Mr. Gray, also a list of mineral specimens collected from the various mines examined.

2. I beg to enclose detailed accounts of expenses incurred by the Assistant Mineral Surveyor and his party, in carrying out the investigations ordered by Mr. Batten, and I request the favor of your procuring the Lieutenant-Governor's sanction to the disbursement of Rupees 1,476-13-4.*
- | | | | |
|--------------------|------------------|-----------|----------|
| * For October 1855 | 300 | 15 | 4 |
| „ Novr. 1855 | 249 | 15 | 0 |
| „ Decr. 1855 | 429 | 4 | 7 |
| „ Jan'y. 1856 | 284 | 14 | 4 |
| „ Feby. 1856 | 211 | 12 | 1 |
| | <u>Rs. 1,476</u> | <u>13</u> | <u>4</u> |

3. The iron mines described in the Report are worthless from their position, as they are all situated at a great distance from the plains, and iron ore deposits of equal, if not of superior quality, are abundant much nearer to the plains; but Colonel Drummond's discovery of iron on the outer ranges renders all such deposits in the interior of the hills comparatively valueless.

Mr. Barratt's Report on copper is very encouraging, but I do not recommend any attempt being made to improve the present mines for the benefit of Native lessees. The increase of Revenue on opening the mines, anticipated by Mr. Barratt, is too trifling to be thought of for a moment, and there is no *necessity* for increasing the supply of copper in the Province; the only object that could be gained would be a handsome remuneration to the first lessee.

It appears from Mr. Barratt's Report that the lead mines would be productive, if worked on a large scale, but if lead was produced in abundance, the price would fall far below the value specified in this Report. The localities where the best specimens were found are ten marches from the plains, and this would be a serious objection to having extensive works at either place, however rich the deposits may be.

In conclusion, I solicit instructions regarding the future employment of Messrs. Barratt and Gray. Their services cannot be made use of at Dechowree, as they are not, I believe, acquainted with smelting, and miners are not required there. If they can be made useful in any other district, they are now available ; if there is no further occasion for their services, they had better be sent back to England at once.

I have the honor to be, &c,

(Signed) H. RAMSAY,
Commissioner.

KUMAON COMR.'S OFFICE, }
The 29th Feb. 1856. }

N. B.—If the specimens are required they can be sent to Agra at once.

(COPY.)

No. 21.

FROM

JAMES BARRATT, ESQUIRE,
Assistant Mineral Surveyor,

TO

CAPTAIN H. RAMSAY,
Commissioner, Kumaon.

Haridwar, 20th February 1856.

SIR,

I BEG to hand you a Report of my examinations in a recent tour through portions of metalliferous districts in Kumaon and Gurhwal, which I hope will meet your approbation. J. H. Batten, Esq., late Commissioner, previous to my departure for Gurhwal, mentioned about visiting and examining the Mussoorie lead mines, also some lead mines up the Aluknunda River, on the Badrinath Road ; the names I have forgotten, but know a person who has seen them. I recommend a small trial on the back of Jâk lead lode ; and Mr. Gray, if you approve of it,

could remain there, while myself, accompanied by Mr. Charles Thomas, the Interpreter, could be examining elsewhere, where you may be pleased to appoint. Since our departure from Ják, Note Singh has discovered a large lode at Usheer, and from the specimens presented, it contains a great portion of sulphur. Waiting orders.

I have, &c.,
(Signed) JAMES BARRATT,
Assistant Mineral Surveyor.

No. 22.

(COPY.)

To

CAPTAIN H. RAMSAY,
Commissioner, Kumaon.

Almorah, 20th February 1856.

SIR,

HAVING been directed by John H. Batten, Esquire, late Commissioner, to investigate portions of metalliferous districts in Kumaon and Gurhwal, I beg, in conformity with my instructions after a tour accompanied by Mr. Thomas Gray, (Miner,) and Mr. Charles Thomas, (Interpreter,) to hand you a Report of my examinations.

First.—New Copper Mines examined are Pepulee, Pringlapanni, and Murbuggettee.

No. 1. Pepulee Copper.—My attention was drawn to a place, about half a mile North-West of Pepulee village, by a Native who discovered some beautiful specimens of yellow copper ore (copper pyrites) which evidently were brought down by a land-slip from near the summit of the mountain. He informed me, the people of the place have, in and after the wet season, collected several baskets of rich copper ore, and carried them to Dobree to be smelted. If this place was well explored, the main lode would be met with above the slip in the mountain; the ore is very rich and encased in a very congenial stratum (white clay slate). No mine was ever worked that I could see on the spot, where the specimens were found and the stratum very much broken and displaced. I explored the Gutgwar Glen where the rock was divided, but could not find the lode, probably it would take several days to discover it, which was more time than I could fitly devote to that purpose, in the present examination; however, if at any time, any European should be stationed in this mining locality, or at another convenient season, I should recom-

mend to examine the mountain where probably a good lode might be discovered. If any thing could be discovered here, there is a fine stream of water sufficient for stamping, dressing, and all other mining purposes. The Natives never remembered any mine here (only surface-digging in the land-slip,) but, about three miles West, in a line with the bearing of the stratum on the South side of the Butchingurd River, there is an old copper mine (not in operation) worked last by the Rajahs, just under the Butchingurd village. There are several old mines in this district, (Dewulgurh,) but no copper mines are in operation. Very little expense would open some of them and would be good for the improvement of the poor race of people who occupy this district, and who are desirous to get employment. If Government feels disposed to open them, probably, after a few years, would receive a good interest for the capital laid out, (good mines idle are good-for-nothing).

No. 2. Pringlapanni Copper Mine is situated about a mile North of Biergunga Bridge, on the western bank of the Aluknunda River, in Mullah Nagpore. The lode which is very wide, bears N. N. E. and S. S. W. and dip an angle of 45° W. N. W. ; is chiefly composed of quartz and a little copper pyrites, mixed with black oxide of copper and iron pyrites, the quartz much tinctured with the green carbonate of copper. It is not very rich nor very promising from present appearances, but if wrought to a greater extent, probably, would prove a remunerative mine. Very little has been done towards exploring it. The lode is embedded in a bluish clay slate. Wood is not abundant, sufficient only for Native smelting.

No. 3. Murbuggettee Copper Lode.—This metalliferous formation is situated about a quarter of a mile North-East from Murbuggettee village, and about two miles up the Nundaknee or Nundgunga River from Nundprag, in Puttee Barhasee, (pergunnah Desolce). The lode, which is about 8 feet wide, is chiefly composed of quartz, a little clay slate, and yellow copper ore, (copper pyrites,) and thickly impregnated throughout with the green carbonate of copper. Its bearing is W. N. W. and E. S. E. and dip at an angle of 50° N. N. E., and bears through a whitish clay slate. Nothing has been done on it. It is a large promising lode, and would, from appearances, if explored, prove productive. It is quite accessible, the back or out-crop being divided and exposed by a rivulet. The mountains, on both sides, rise almost perpendicular ; and a drift commenced in the out-crop would soon leave high-dry, and probably

valuable mining ground. Water is abundant, and woods on the mountains afford inexhaustible supplies for fuel and timber, both of oak and pine, for all mining requisites.

Second.—Old Copper Mines examined are Kerraye, Belar, Raie, Seera, Tomacotee, Dobree, and Dhunpore.

No. 4. Kerraye Copper Mine is situated at Ujolee, in Puttee Kerraye, (pergunnah Chewgurkha.) The mining operations are at present confined to driving of a level or gallery on the course of the lode which bears S. E. and N. W. and dip at an angle of 30° S. W. It appears the lode, or metalliferous course, is very wide of talc quartz, thin layers of limestone and a little iron in the talc. Small lines or veins of yellow and purple copper ore are met with; the quartz is also slightly impregnated with copper ore and coated with the green carbonate of copper. It is generally very poor. A great quantity of the lode or metalliferous talcose matter must be raised, washed, and dressed, to obtain a small quantity of copper ore. Several men are employed in the mine, and women at surface, who cleanse and prepare the ore for the smelter. This mine is not very rich although the lode is very wide and very easily wrought; the ore is so thinly deposited in it, and so much required to be cleansed for so small a quantity of copper, that it is only the Natives who work so very cheap, can realize a mere living by it. Wood and water, for all requisite mining purposes, can be obtained immediately on the mine.

No. 5. Belar Copper Mine in Gougolee is situated close by the village of the same name. Considerable old workings are traced in a North and South direction, all of which are choked; the lode bears about North and South. It is a talcose course, mixed with quartz, thinly impregnated with yellow and purple copper ore, with occasional stones of the black oxide of Manganese. All mining operations have been suspended for some time, the mine fallen in and abandoned. There is nothing here to be seen externally that will warrant any outlay on it; the Natives inform me it was very poor and the cause of its abandonment. Wood can be plentifully obtained on and near the mine, but no water for mining purposes in the vicinity.

No. 6. Raie Copper Mine in Gougolee is at present choked, ruined, abandoned, and grown over with brushwood. Nothing at present can be seen within it, but considerable old workings have been made and formerly it yielded great quantities of copper ore, and from neglect in securing it, has fallen in. I was informed by the Natives that there was

a good lode of ore in it when it was suspended in the virgin or unwrought ground. It cannot be worked properly without putting in a deep adit or gallery, which is a matter of consideration ; the expense would be enormous and probably would require more money than could be realized for a considerable time after it was re-opened. Looking at the dilapidated and ruinous state of the mine, generally, in my opinion it does not hold out sufficient inducement for the expense of re-opening. The ore is copper pyrites, thinly deposited in quartz and talc-slate, in beds of limestone, with occasional layers of clay-slate.

No. 7. Seera Copper Mine is situated close by Agur village. The deep adit or mean gallery is commenced in the side of the mountain and extended in a southerly direction for about 60 fathoms, cutting the stratum and metalliferous veins at right angles, several of which were met with, and extensive workings have been made on them. The mean and most productive lode is at the end of the gallery, but for want of air the miners were obliged to abandon it, in about 45 fathoms, from the entrance ; the timber which was put to secure the lode, had crushed, which prevented me from examining the end or most productive workings. Mining operations are now confined to the clearing of a shallow adit or gallery, about six fathoms above the mean, but no minerals of any kind have yet been found. The mineral, from the mean workings, is yellow copper ore, mixed with iron pyrites, generally found deposited in quartz and talc, the stratum is a limestone. This mine, like many others, is falling into ruin for the want of more commodious galleries to facilitate the operations and a better system of ventilation. In order to make it a good mine, or to work it in a mining-like manner, a deep adit should be commenced, to come in about 10 fathoms under the present deep adit, which should be communicated with each other, at convenient distances. To give the required ventilation, this would require a level, 100 fathoms in length, which must be driven through a hard limestone rock and probably require more money than the mine is worth, although there is a great quantity of ore in the inner workings, by Native information, it must, from the decay of the securing, bad ventilation, &c., soon fall into ruin and be abandoned.

No. 8. Tomacotee Copper Mine is situated at Agur, on the western side of the Ram Gunga, about three miles N. N. W. from Lohba. It has two entrances up about 20 fathoms perpendicular from the base of the mountain. The mean entrance, through which the ore is extracted, is sunk

to the depth of 15 fathoms on the dip of the lode, whose bearing is N. W. and S. E. and dip at an angle of 50° S. W. It is from 6 to 8 feet wide, thickly impregnated with the green carbonate of copper, with small deposits of purple copper ore and copper pyrites ; the rocks about it is a quartzose clay slate. It is a large promising lode, and worthy of exploration. It has a pretty gossan (a reddish decomposed quartz, mixed with a little iron,) which is considered by miners to be a good indication in copper lodes. Looking at the congenial rock it is embedded in, and the promising appearance of the lode, generally, it is my opinion that if explored, would in depth prove very productive. The miners are at present idle for the want of a new lease, and the mine about five fathoms from bottom has commenced to fall in, which prevented me from examining the bottom at the present workings. If not worked in a little time, the miners will be obliged to abandon it altogether. I beg to recommend for your consideration, that a deep horizontal gallery, (cross-cut,) be driven at right angles with the lode to intersect it, commencing at the base of the mountain, the distance will be about 25 fathoms at twenty-five (25) Rupees per fathom will be equal to five-hundred (500) Rupees, the sum required to intersect the lode, which will come in several fathoms under the present workings, will open mining ground for years, and will, without doubt, ultimately prove beneficial to Government. The mine then would quickly be leased at one hundred (100) Rupees, probably more, per annum, instead of ten (10) at present, as in the last lease. There are great complaints with the old lessees by not obtaining a new lease. They directly earn their subsistence by mining, and being idle, feel it very much. They say the scarcity of copper is felt very much, and if they were working, could readily sell their copper at two Rupees four annas (2-4) per seer. I strongly recommend to grant them a new lease, they will, for their own safety, secure the old workings, and save the mine from ruin. If Government should approve and sanction the driving of a new gallery, the Native works will not interfere ; they can continue their mining till the new horizontal gallery intersect the lode, then they could be put to work on another system. There is a two-fold reason for their working, *viz.* they will be sinking in their deepest workings towards the point the new gallery will intersect, and by keeping their old workings open, will tend to ventilate the mine. After the new gallery intersects the lode, they will also be paying a trifle to Government. This mine is so situated that every facility is offered to carry it on in a very economical scale.

Wood, in the immediate neighbourhood, for charcoal and all other mining purposes, is inexhaustible, the mountains are completely covered with oak and pine ; and water, any supply from the Ram Gunga, can be obtained for cleansing the ore ; and if the mine should prove rich below the base of the mountain, any diameter-wheel necessary for drainage can be erected, and driven by a never-failing stream (Ram Gunga) close to the mine.

No. 9. Dobree Copper Mine is situated close to Dobree village, and the only one at present in operation, is very rich. It has one entrance commenced in the side of the mountain, in the out-crop of the lode, where the miners met with a shoot of ore dipping eastward, and have extended their workings on the course of it from 12 to 15 fathoms, at the point they now work. The lode, which bears W. N. W. and E. S. E. and dip at an angle of 10° S. S. W., is above 2 feet wide, of very rich copper pyrites, mixed with purple copper ore and a little quartz. It will yield five tons of ore per fathom* worth £10 per ton, equal to £50 per fathom. Owing to their irregular workings, the air in their drift is become very foul, so much so, that a candle will not burn ; and the men, who are six to one, hammer and chisel, (gad) relieve each other at short intervals, are obliged to work in the dark, or without light, one at a time, the other five remain outside the mouth of the mine in fresh air to revive themselves. The period of working is about ten minutes together, which shows the necessity of a new mining system in this district. If an adit or gallery was commenced and drifted in lower down the mountain, so as to intersect the lode at right angles, it would serve to bring away their ore, and also to drain and ventilate the mine. Water is beginning to trouble them ; they are obliged to dip and carry it up through their workings to surface. Although the mine is rich, from the influx of water, bad ventilation, and the unsystematical manner it is worked, mining operations must, certainly, soon cease if means are not taken to ventilate it. I strongly recommend an horizontal gallery to be driven at right angles, with the lode commencing at a convenient spot, under the mine, to come in under the present workings, which will be about 15 fathoms, to drive through a limestone rock, and probably would cost sixty (60) Rupees per fathom, making the amount, or sum required, to

* A fathom in this calculation is 6 feet long, 6 feet high, and the breadth of the lode ; and 6 feet long, 6 feet high, and 6 inches wide of the lode, is supposed to make a ton.

intersect the lode, nine hundred (900) Rupees. This being done, the mine will be thoroughly ventilated, would serve also for drainage, and the more expeditious removal of all ores, leads, &c. ; and the lessee would certainly be in a position to pay double the amount of rent than he at present pays. One good thing in this mining district is, the miners are accustomed to work by night, as well as by day, consequently any portion of mining can be more expeditiously done there than in many other mining localities. There are several old mines there, and the greater part of them, I have been informed, are not abandoned through poverty only, but for the want of ventilation and a better system of mining. The stratum is generally a limestone, but, where the best deposits of ore are met with, a little clay-slate is also met with on both sides of the lode. I perceive a great loss in the Native process of smelting, although the ore yield 8 or 9 per cent., they do not extract more than from 3 to 4. When I was there 50 seers of mineral were employed or smelted, it produced 5 seers, or 10 lbs., of regal (coarse copper from first process of smelting,) which gives about one-third fine copper, equal to $3\frac{1}{2}$ lbs. or $3\frac{1}{2}$ per cent., showing a great loss. Copper sells well there, two (2) Rupees per seer, equal to £224 per ton, which shows the value of copper mines in the Himalayas.

No. 10. *Dhunpore Copper Mine* is situated about a quarter of a mile West of Dhunpore village, on the summit, or nearly off the mountain. The copper lode, or metalliferous formation, is a great many fathoms wide, bears about East and West, is chiefly composed of quartz and limestone, the quartz thickly impregnated with the green carbonate of copper, and occasional deposits of copper pyrites, mixed with purple and vitreous copper ore of very good quality. In the present drift, or the one which yields the best ore, the branch (small vein) is about four inches wide, of vitreous copper ore, of about 40 per cent. In this drift very little is doing on account of the rocks being very hard, the miners, not yet knowing the process of blasting, after digging forth the copper vein, burn the rock to soften it, then they cut it away with chisels. Many other parts of the mine are worked for the carbonates which are profitably smelted. It contains a great quantity of ore, but not so rich as formerly, however copper lodes fluctuate, probably it may be soon rich again ; large lodes make large deposits, and again dwindle and close almost to nothing ; it appears these rich deposits here are met with when the cross branches intersect the East and West veins at the junctions. Twenty-five men are employ-

ed in this mine, and two furnaces are in continual operation, three more are to be put in operation immediately, with an additional number of miners. Here 100 lbs. of ore gave 8 lbs. of regal, which makes the yield of copper $2\frac{2}{3}$ per cent., this was from the inferior ore, the carbonated quartz; some other ore has been smelted which yielded 5 per cent., this was a mixture of both ores. I am pretty sure the copper of this mine is argentiferous, and would recommend analysis to be made to ascertain the proportion contained in a ton, probably it is rich enough to pay the expenses of separation and leave profit. The system of mining here appears pretty good as regards ventilation, they have one level above the other, with frequent communications, which keep the mine well ventilated. I strongly recommend to introduce blasting. If once the miners know it, they will appreciate it; they would be able to carry more commodious galleries; and both Government and them would ultimately receive the benefit of it, so much more work would be accomplished, in much less time, which would cover the expense an hundred-fold, and would be found much more profitable than the slow tardy system now in practice. The copper mines recommended to be opened are Tomacotee and Dobree. If Government feel disposed to open them, would doubtless, ultimately be handsomely repaid for the outlay. I am not of opinion that Government could realize much money for a few years, but after the mines are opened, the lessees would be in a position to pay considerable more dues or rent, and it would be opening the way for private capital, which if invested in Dhunpore and Dobree districts, and judiciously carried out, could not, in my opinion, fail to become very remunerative. There are very rich deposits of copper ore in those mines, and if the explorations and workings were carried on in a large scale, and on the English system of mining, considerable quantities of copper could be extracted. The mountains between Dhunpore and Dobree and Dewalgurh on the same lode or course, if explored, would be found to yield abundance of mineral. Several of the minor mines, though not very urgently recommended, which have very little done to prove their value, may, if opened, prove equally valuable, as those that are found rich are by being more extensively wrought. At Dhunpore the best, and by far the richest, part of the mine is most completely suspended, because the rock is hard, and ore of 40 per cent. remains worthless in the ground because it cannot be extracted by the Native system of mining; and at the same time the miners are extracting and smelting ore of 3 per cent.,

when if they knew the process of blasting, it could be very easily taken away, or extracted, without any difficulty whatever, and turned at once to profitable account. In all the mines blasting is indispensably necessary, should be introduced, and the old system of burning and chisling be dispensed with.

Third.—New Iron Mines visited are Badersaie, Bomaatha Cherry Khan, Hartjasal, Harthakhan and Bejouragurd.

No. 11. Badersaie Iron Mine is situated about a quarter of a mile West of Dhunpore Copper Mine. Several old pits are scaled in and grown over with brushwood. In digging in some of them, discovered some beautiful specimens of red oxide of iron and red hematite of 70 per cent. metal. It appears to have slidden down from the North side of Dhunpore great metalliferous formation. Any quantity of very rich iron ore can be obtained already broken and lying on the surface (no one remembered it in operation.) The lessee of Dhunpore and Dobree copper mines is desirous to obtain a lease to work this mine to get iron for his consumption in the copper mines. Wood is sufficient in the neighbourhood for Native smelting.

No. 12. Bomaatha Cherry Khan is situated about half a mile South of Soogee village, near Chutnapeepul, in Mullah Nagpore. The mine is high on the side of the mountain; its lode, which is about 3 feet wide, bears N. N. W. and S. S. E. and dip at an angle of 10° E. N. E.; is chiefly composed of quartz, with micaceous and specular iron ore, of good quality, but not abundant. Several rich specimens were taken from the North side of the lode, but they do not yield supplies for furnaces. It is embedded in a bluish clay slate. It appears iron is not wrought here, or only in such quantity to meet the lessee's consumption. Wood is abundant.

No. 13. Hartjasal Iron Mine is situated about a mile West of Hart village, in Mullah Nagpore. The lode which is seen cropping out for 8 fathoms wide, is composed of micaceous specular and brown iron ore, with occasional layers of blue clay and quartzose slate. Its bearing is N. N. E. and S. S. W. and dips W. N. W. at an angle of 20° . The ore is very rich and abundant: it is quite accessible, and in about one hundred fathoms from the North banks of the Aluknunda River, although very rich, little is doing on it. The lessee only pays 4 Rupees per annum, which shows that iron is not of much value so far back in the mountains. Wood is not very abundant on the mine or in its vicinity, but sufficient for Native smelting.

No. 14. Harthakhan Iron Mine is situated about a quarter of a mile West of Hart village, in Mullah Nagpore, in the side of a very steep mountain, the excavation, rather than a mine, is commenced in the out-crop of the lode which is wrought for about 12 feet long and 12 feet wide in a mass of pure micaceous iron ore of 75 per cent. metal. The lode is seen for a considerable breadth and very rich, but very little has been done to turn it to profitable account (this is a continuation of Hartjasal lode.) Smelting is not spiritedly carried on here, the Natives only mine and smelt for their own consumption. Wood is very scarce on the mine, but close on the South side of the Aluknunda, the mountains afford plenty for mining and smelting purposes. Limestone can be had in any quantity both on this and Hartjasal mine. If there had been any call for iron in those districts, these mines would supply any quantity. Thousands of tons of rich iron ore are already broken and lying on the surface.

No. 15. Bejouragurd Iron Mine is situated about a quarter of a mile South of Palsonee village, in Puttee Kerrakate, (pergunnah Beedhan.) It is high and accessible in the side of the mountain. Very little has been done on it. Attempts to smelt the ore has been made, but iron could not be obtained from it. The lode is about 12 feet wide, bearing East and West, and dips about 30° North. Its composition is quartz blue-clay slate, a little iron, and *blende*, with occasional spots of lead ore. It is encased in a quartzose stratum, but very poor and offers very little inducement for further exploration. The Pinder River passes just under the mine. The farther West at Narinebuggah is the Rajah Khan Iron Mine in the same lode, where considerable old workings are to be seen grown over with brushwood; the new mine here on the eastern part of the old workings, scaled in the last wet season; this opening yielding good ore, and the Natives inform me it is rich, and if explored, would yield abundance of rich iron ore.

Fourth.—Old Iron Mines investigated are the Danda, Davee Khan, Rajah Khan, Mokka Khan, and Calabun.

No. 16. Danda Iron Mine is situated about a mile North, and above the Doongra village, in Dewulgurh. It has a great many old shafts or openings, but are all at present choked, which prevented internal investigation. It has been suspended for the last ten years. A resident guide informed me, the lode was at times as much as 3 feet wide, and at others dwindles almost to nothing; the ore is a common brown iron ore, not very rich. From a few specimens collected on the surface, it appears to yield

about 30 per cent. metal. About 30 fathoms below, immense detached rocks of ore are seen cropping out the surface, of a little better quality, but so hard that the miner and smelter reject them. The lode bears about East and West, asvestas is also found mixed with the ore. Above the mine a large formation is seen cropping out, where abundance of limestone is procurable. It is my opinion the mine is worked in a broken stratum, (a land-slip;) and that the main lode is above; the miners had great difficulty in keeping abroad their galleries, the rock being so broken up, which evidently shows the whole mass, on which the mine is worked, came down from above, and if explored, without doubt, a large and rich lode would be discovered. Wood for charcoal and mining purposes is rather scarce in the immediate neighbourhood, but about 3 miles up the Butchingurd Valley, there is plenty of prime oak, and also on the Butchmone Mountains about 3 miles South of the mine.

No. 17. *Davee Khan Iron Mine* is situated about one hundred fathoms South-East of Doongra village, in Dewulgurh. It had several openings but at present, are all scaled in and choked. It appears this mine, like the Danda, is not worked on the rock, in its primitive position; the Native miners inform me, they sink pits in the rubbish that previously came down from the great formation above, from very near the summit of the mountain, in which they find rocks of iron ore (no regular vein) sometimes rich, and at others very poor, and cannot sink or drift far because their galleries fall in and fill the mine with rubbish. It may be called quarry rather than mining. This mine has not been suspended long, and when last in operation, it supplied 13 furnaces for about three months in the year, which were situated in the following villages, viz.: Bawuso-ore, Gober-ore, Darnacote-ore, Taileete-ore, Surraree-ore, Coilee-ore, Pata-ore, Peepulee-ore, Paroh-ore, Gubar-ore, Chundee-ore, and Domgratwo-ore. It does not appear they used to carry much iron to market; they only get a little for their own consumption, and the supply of a few minor villages, who take no part in the mining and smelting. These mines cannot be very profitable to them, looking at the distance they have to fetch charcoal and the hazard in the supply of mineral which must be all calcined before they can smelt it. The old lessees paid 25 Rupees per annum, and if they obtain a new lease, at the same rent, they cannot make much profit. The miners are generally very poor. The Natives, who are very numerous and very poor, are desirous to obtain a new lease; the mines are better leased and kept in operation than left idle. They will be kept

open and saved from ruin. It is very likely English capital will be invested in iron in this locality, however the mines will do to lease to the Natives who will be paying a trifle to Government and keep them from idleness.

No. 18. *Rajah Khan Iron Mine* is situated about three quarters of a mile South-East of Augur village, in Puttee Nagpore. It has several entrances, several of which are choked. The main entrance or excavation is wrought for about 15 fathoms in a westerly direction, and in places for 4 fathoms wide ; the lode bears East and West and dip about 30° North. Its breadth is from 10 to 15 fathoms wide, of brown iron ore of from 25 to 30 per cent. metal. It supplies three furnaces in Augur village and several others in scattered villages in the neighbourhood. At the entrance of several old galleries, which are choked within in the South side of this enormous formation, several stones, containing copper, were found, *viz.* copper pyrites, grey sulphurat, and green carbonate of copper. It is encased in a tât case slate. Wood is sufficient in the neighbourhood for Native smelting only.

No. 19. *Mokka Khan Iron Mines* are situated in the summit of Kalloo or Katoolee Mountain, about two miles South of Moh village, in pergunnah Budhan. They are not very extensively wrought at present ; numerous old mines are abandoned and scaled in. The lode bears N. N. W. and S. S. E. and dip E. N. E. at an angle of about 50°. The present mine, which is open, is worked in a direction at right angles with the lode in a mass of steely black oxide of iron (magnetic) of 70° per cent. It is so compact and hard, that the Natives are obliged to burn the ore before they can extract it. It is a superior fine, hard, valuable iron and very much prized by the Natives. It appears to be worked by the inhabitants only when necessity requires, then each person mine and smelt for himself, according to his wants. Any quantity of very rich iron ore can be obtained from the mine, and the extensive oak, pine, and deodar forests in the mines are inexhaustible. The breadth of this rich iron lode is not to be ascertained ; the miners do not work or carry the whole breadth of it in their excavation, and the surface is completely covered with brushwood and trees which prevent seeing the out-crop to ascertain it there ; but from the direction of the old mines, it must be a great many fathoms wide. It was traced in a southerly direction in our journey to Jâk for 4 or 5 miles ; and several old abandoned mines, and remains of ancient smelting works, are to be seen in it.

No. 20. Calabun Iron Mine is situated in the South side of Budhan. It has two openings, the North one, which is scaled in, is about 3 fathoms deep, the southermost about 4 feet deep. From this the miners extract their ore. The lode which bears North and South and dip about 40° East, is composed chiefly of specular iron ore, of from 60 to 70 per cent. The metalliferous part is about 4 feet wide, encased in a coarse grey porphyry (the mountain generally is granite.) There is no smelting works in operation within several miles of the mine. Each person according to his wants mine and carry the ore to his village and smelt it, paying a certain tribute to the ticcadar or lessee on the ore extracted. The lode is very rich, and the iron of a superior quality, and can be raised in abundance. If at any time this mine should be required to be worked on a larger scale, and smelting works should be established in or near the mine, inexhaustible supplies of fuel can be obtained from the extensive oak, pine, and birch forests, which cover the mine and its vicinity for miles around. Water can be had in sufficient quantity immediately under the mine.

Fifth.—Lead Mines examined are Raie, Chendâk, Kerraye, Patal, Dhunpore and Jâk.

No. 21. Raie Lead Mine in Gungolee is situated about a quarter of a mile North-East from Raie Copper Mine. It has one opening or irregular shaft which is nearly filled to the surface with rubbish. No lode or mineral of any kind can be detected either in the shaft or in the stratum, which is denuded and exposed around it. At surface it is in a limestone formation, and the workings appear to be inconsiderable. It is worthless from present appearances, but if cleared, or re-opened, might recommend itself, (no one remembers it in operation or have seen any mineral from it.) It does not recommend itself from present indications, and in my opinion, is not worthy of further exploration.

No. 22. Chendâk Lead Mine is situated about two miles East from Chuna village, in Goron. It has three openings in the out-crop of the lode nearly on the summit of the mountain. In the middle or deepest, extensive working has been made. On the dip of the lode which bears W. S. W. and E. S. E. and dip at an angle of about 60° N. N. W., it is embedded in a compact limestone; and the lode which is from 6 to 8 feet wide, is chiefly composed of limestone, with small veins of quartz, in which the lead ore is very securely deposited. Wood for smelting and mining purposes cannot be obtained within several miles of the mine; and water

for cleansing cannot be had within two or three miles. Looking at the hard extensive rock, it is embedded in the scarcity of wood and water and the insufficiency of minerals, it appears no inducement whatever for outlay or trial, nor can any miner recommend it from the appearance of the lode or the indications it generally presents.

No. 23. Kerraye Lead Mine is situated on the top of Tapolec Hill, about 2 miles North from Kerraye Copper Mine, in Puttee Kerraye, (pergunnah Chewgurka.) No regular lode can be seen. Stones containing lead ore are met without throughout the limestone formation, which is several fathoms wide, bearing North and South. Several old mines or pits are sunk on the top of the hill, most of which are scaled in and grown over with trees and brushwood. It is a very hard, compact limestone, very thinly impregnated with the lead; the whole hill appears to be slightly metalliferous, but so thinly deposited, and the rock so hard and difficult to wrought; it offers no inducement for either public or private capital. No one remembers it in operation. Supposed to be worked last by the Goorkhas.

No. 24. Patal Lead Mine is situated a quarter of a mile North of Patal village, in Dewulgurh, on the North side of the Butchingurd River. On finding its entrance choked, employed men and cleared it so as to enter 18 fathoms in the mine. The level or gallery which is very small, is driven on the course of the lode, which bears E. N. E. and W. S. W., and dip at an angle of 45° S. S. E. At the entrance it is about 8 inches wide, and about 6 fathoms it is 2 feet wide of quartz; it does not show a particle of mineral, but has a very promising appearance. At the end of the main gallery a cross-cut or branch gallery is extended North, where it intersects another lode chiefly composed of quartz, on which a sink or diagonal gallery is made on the dip of the lode which was full of water. The main workings are all under this level and filled with mud and water which prevented examination. Considerable working has been made, and from the great quantity of Scorins laying on the surface, evidently shows the mine once to have yielded mineral. It is situated convenient to water-power, and wood abundant for charcoal and all mining purposes. The lode is embedded in a beautiful blue clay slate which is a very congenial structure for lead. An adit or gallery for the extraction of ore and which would serve for drainage, could be put in at a trifling expense, to drain the old workings and give it a trial.

No. 25. Dhunpore Lead Mine is situated in the side of a steep mountain at Rulleean Dhonuka Dooleka, about two miles South-East from

Dhunpore village. It has two entrances or diagonal galleries sunk on the dip of the lode, the westernmost one about 3 fathoms, and the other, which is about 4 fathoms East, is 10 fathoms deep. It appears, the old miners met with a shoot of ore (lead ore) in the out-crop, and followed it down in an easterly direction on which considerable workings have been made. In breaking some of the lode we found it thickly impregnated with lead, and in the gossan (a brownish decomposed quartz) the green carbonate of copper. In the western workings, a good deposit of lead is to be seen from which we broke 13 seers of good lead ore. In this sink no very extensive workings have been made but far richer than the eastern ore. The lode bears East and West and dip about 40° South into the hill. Its breadth cannot be ascertained from the out-crop being thickly grown over with trees and brushwood, &c., nor can it be ascertained in the mine; the miners did not carry the whole breadth of it in their workings, only one wall (side) is to be seen, the North one. It is worked on for about 12 feet wide, chiefly composed of a brownish quartz, mixed with a little limestone, the whole thickly impregnated with granular lead (galena.) Although this mine has not been leased, the Natives of the neighbourhood have worked it occasionally, probably for the lead or silver or both, (it is doubtless argentiferous.) It is so situated that any required depth of adit or gallery can be brought in for drainage, but being situated so high, drainage will not be required for a considerable time, if worked with great force. It was left rich. Ore can be broken at once; and a stream, less than a quarter of a mile from the mine, affords sufficient water for dressing and all other mining purposes. If this mine was in Cornwall, with such facilities as is here offered, it would let at five (5) shillings in the lb, or one quarter of the produce, and great profits would be realized from it. Wood for charcoal and all mining requisites can be obtained on and directly East of the mine. The 13 seers of ore were taken back to Dhunpore, and after selecting the best specimens to take back, and samples to ascertain the proportion of silver smelted; the remainder or refuse, which was about $11\frac{1}{2}$ seers of ore, produced $1\frac{1}{2}$ lb. of lead, equal to $6\frac{1}{2}$ per cent. It was not dressed or cleansed and smelted, less the best specimens with the dirt as taken from the mine.

No. 26. *Jāk Silver Lead Mine* is opened close to the western end of Jāk village, in Puttee Kurra Kote, (pergunnah Budhun.) At the place where the silver lead (argentiferous galena) was found, we commenced opening, and found the lode, which was very much disordered, and the

stratum very much broken, to bear S. E. and N. W. and dipping N. E. It is composed chiefly of quartz, mixed with clay slate, which make at intervals rich deposits of lead ore; and stones from 2 to 15 lbs. weight have been extracted from it which will yield 50 per cent. lead. Being so near the surface, it does not take a regular bearing, (inclination,) but if explored, would in depth be found more settled and probably productive. It has every indication of becoming a valuable lode, and I strongly recommend to sink a shaft 10 fathoms diagonally on its dip, which will give it a little trial. About 150 lbs. of lead ore were taken from the lode, and rubbish, which will yield 25 seers of pure lead, equal to $33\frac{1}{3}$ per cent. It is embedded in a greyish clay slate. Such metalliferous and promising lodes deserve trial, and the specimens found will recommend it. About 300 Rupees will prove it 10 fathoms deep, including the expense of drifting a few fathoms East and West in its course at the bottom of the shaft. If a good mine should be met with here, wood, (prime oak,) within a short distance, is inexhaustible; and water, for all mining purposes, can be had just under the mine from the Pindar River. Every facility is here offered for carrying on extensive mining operations which can be carried out very economically. The lead of this mine will yield silver and should be assayed to ascertain the exact proportion. If the mine was worked in a mining-like manner, it is my opinion that it would be found rich and remunerative. This lode is also seen cropping out by the side of the road leading from Jâk to Biergong village. About 80 fathoms, in a South-East direction below the mine, where it is more settled and has a very promising appearance, a small trial should be made in the out-crop at this point also.

It will be seen that of the Lead Mines Dhunpore and Jâk are the most promising, and can, doubtless, be made, with little outlay, remunerative. If lead should be required in the hills "it can be raised at once in Dhunpore Mine, and if it should prove argentiferous (of which there is no doubt,) it will be found a valuable concern and could be profitably worked, looking at the enormous price lead sells at, *viz.* £40 per ton."

No. 6. *Gold.* In travelling we discovered parties washing the auriferous sand of the Aluknunda, and from the gold obtained from a certain quantity of sand, it appears to be very profitable to them. Gold is very much worn by the inhabitants in rings and other decorations, which I was informed is taken from the rivers. We found by trials made also on the Pindar and Memduknee Rivers, that the sands were auriferous and the precious metal detected in each of them, the Aluknunda by far the richest. If

washings were carried out on a large scale by the new improved methods for washing and obtaining gold, where labour is so cheap, without doubt, could be turned to profitable account.

Several other mines, besides those previously mentioned, came under my notice, but not worthy of place here. It appears there are in Gurhwal a great number of metalliferous deposits which have not yet been visited by Europeans, many of which bordering on the lower range of the Himalayas, if examined could be prosecuted and probably turned to profitable account.

I beg to say that my companions through our tours laboured zealously, as well as myself, to promote the objects of our mission, the results of which, I hope, will meet the approbation of our employers and also of the Commissioners of the Provinces who were pleased to appoint the investigation.

I have, &c.,
(Signed) JAMES BARRATT,
Assistant Mineral Surveyor.

List of Mineral Specimens collected from the various Mines examined.

Number of Specimens answers	Names of Mines.	Names of Mineral.	Names of Pattice.	Province.	Remarks.
No. 1	Peeplee	Copper pyrites	Butchingurd	Gurhwal	Not opened.
" 2	Pringlapanni	Copper pyrites, black oxide, and green carbonate of copper	Nagpore	Ditto	Explorations limited.
" 3	Marbuggettee	No specimens	Ditto	Ditto	Ditto.
" 4	Kerraye	Yellow pyrites and purple copper ore	Kerraye	Kumaon	Extensively wrought, but not rich.
" 5	Belar	Black oxide of manganese	Gungolee	Ditto	Abandoned.
" 6	Raie	Copper pyrites on slate	Ditto	Ditto	Ditto.
" 7	Seera	No specimens	Ditto	Ditto	Ditto.
" 8	Tonacottee	Purple copper and green carbonate	Chandpore	Gurhwal	Suspended for the present.
" 9	Dobree	Purple copper ore and copper pyrites	Dhumpore	Ditto	Extensively wrought & rich.
" 10	Dhumpore	Vitreous copper pyrites and purple copper ore	Ditto	Ditto	Ditto
" 11	Badersaie	Red oxide of iron and red hematite	Ditto	Ditto	Ore abundant & very rich.
" 12	Bonaotlia	Micaeous and specular iron ore	Nagpore	Ditto	Ore very scarce.
" 13	Khan	Micaeous and brown iron ore	Ditto	Ditto	Ore very rich and abundant.
" 14	Hartiasal	Micaeous iron ore	Ditto	Ditto	Ditto.
" 15	Bejouragard	No specimens	Ditto	Ditto	Ditto.
" 16	Danda	Brown iron ore	Butchingurd	Ditto	Suspended for the present.

List of Mineral Specimens collected from the various Mines examined.—(Continued.)

Number of Specimens answers	Names of Mines.	Names of Mineral.	Names of Puttee.	Province.	Remarks.
No. 17	Dayee Khan	Brown iron ore	Butchingurd	Gurhwal	Suspended for the present.
18	Rajah Khan	Ditto	Nagpore	Ditto	Ore abundant, but not rich.
19	Mokka Khan	Black oxide of iron	Kurrakote	Ditto	Ore abundant & very rich.
20	Calabum	Specular iron ore	Pinderwar	Ditto	Ditto.
21	Rale	No specimens	Ditto	Ditto	Not open.
22	Chendāk	Ditto	Ditto	Ditto	Abandoned.
23	Keraye	Lead ore (galena)	Keraye	Kumaon	Very poor.
24	Patal	No specimens	Ditto	Ditto	Not in operation.
25	Dhumpore	Lead ore (galena)	Dhumpore	Gurhwal	Very promising. Not in operation.
26	Jāk	Ditto	Kurrakote	Ditto	Ditto

(True Copies)

(Signed) R. N. Oldfield,
Asst. Secy. to Govt., N. W. P.

No. 24.
Dr.

Copy.

Abstract of Mineral Survey Cash Account

Cr.

30th Sept. 1855...	To Balance	22 7 4	18th Oct. 1855	By Advance at Almora Treasury	600 0 0
	" October Expenses	300 15 4	25th ditto	" Bill from Mr. Wallace for Brass and Iron Works for Model Fan ...	2 4 9
	" November Expenses	249 15 0			
	" December Expenses	429 4 7			
1856.....	" January Expenses	284 14 4	12th Nov. 1855	" Advance at Almora Treasury ...	500 0 0
	" February Expenses	211 12 1			
29th Feb. 1856 ...	By Balance in hand	393 0 1	16th Jan. 1856	Advance at Almora Treasury ...	800 0 0
	Total, Co.'s Rupees	1902 4 9		Total, Co.'s Rupees	1902 4 9

Havelbargh, 29th February 1856.

(Signed) JAMES BARRATT,
Asst. Mineral Surveyor.

No. 92.

FROM

CAPTAIN H. RAMSAY,

Commissioner, Kumaon Division,

TO

THE SECY. TO THE GOVT. OF INDIA,

*Home Department,**Calcutta.*

PUBLIC WORKS.

SIR,

I HAVE the honor to inform you that, under instructions from the Hon'ble the Lieutenant-Governor, North Western Provinces, I have this day sent to the Allygurh Post Office, to be forwarded thence by the Bullock Train, a Box to your address, containing specimens of Iron Ores.

I have the honor to be,

SIR,

Your most obedient servant,

H. RAMSAY,

Commissioner.

KUMAON COMM'R.'S OFFICE; }

*Camp Haldwanee,**The 2nd March 1856.* }

BHABUR IRON ORES.

List of Specimens, with Remarks.

	No.	Locality.	REMARKS.
GOLAH.	1	Beejapoor,	.. Heavy and rich.
	2	Ditto,	.. Tufarious lime-stone.
	3	Peepul Pokree,	.. Workable, 2 feet bed.
	4	Muchear,	.. 3 feet bed, clayey and poor, good for mixing
	5	Punealee,	.. Micaceous, sandy and poor.
	6	Ditto,	.. Bog ore, workable.
	7	Chownsilla,	.. Narrow bed, poor, but workable

List of Specimens.—(Continued.)

	No.	Locality.	REMARKS.
BOUR RIVER.	8	Bhoomka,	... Good ore, very serviceable.
	9	Ditto,	... Poor but serviceable.
	10	Dechowree,	... Bottom of shaft 20 feet deep.
	10 ^a	Ditto,	... 12 feet below surface green clay.
	11	Ditto,	... From blocks on surface very rich.
	12	Ditto,	... Ditto ditto ditto, rich.
	13	Ditto,	... Ditto, calcined.
	14	Ditto,	... White sand-stone.
	15	Ditto,	... Red ferruginous clay, useful for reducing.
	16	Ditto,	... White fire-clay, requires well preparing.
	17	Ditto,	... High up in the hill, good ore.
	18	Ditto,	... Ditto ditto, hydrated ditto.
	19	Ditto,	... Ditto, poor bog ore.
DUBKA.	20	Ditto,	... Clayey slate, with stains of iron.
	21	Ditto,	... Limestone from Dechowree good.
	22	Shait,	... Surface, specimen poor.
	23	Gugaree,	... Ditto, ditto very poor.
KITCHEREE.	24	Ghutoorah,	... Workable ore, very fair.
	25	Ditto,	... Clayey, workable.
	26	Umrailee,	... Good workable ore.
	27	Ditto,	... Ditto ditto.
	28	Ditto,	... Ditto ditto.
	29	Ditto,	... Poor, but workable.
	30	Pat Kôl,	... Ferruginous Quartz refractory.
KOSSILLA.	31	Ditto,	... Refractory.
	32	Bhora Kôt,	... Ditto } Quartz.
	33	Ditto,	... Ditto }
	34	Ghaitee Paher,	... Poor, but workable.
	35	Choopra,	... Ditto, ditto.
	36	Mooka Gharee,	... Ditto, ditto, much on surface.
	37	Dungar Nuddae,	... Heavy rich and iron ore.
	38	Ditto,	... White clay interspersed.
	39	Panoad,	... Poor, much on surface.
	40	Chookam,	... Workable, small bed.
RAMGUNGA.	41	Choopra,	... Limestone, tufaceous.
	42	Kossilla,	... Ditto ditto.
	43	Ghurra,	... 4 feet bed, poor but workable.
	44	Ramgunga,	... Small bed, poor.
	45	Ditto,	... Ditto ditto.
	46	Ditto,	... Below Ghurra good workable ore.
	47	Ditto,	... Limestone tufaceous, near Ghurrur.
	48	Boxsur,	... Fair, workable, much on surface.
	49	Patlee Doon,	... Workable,
	50	Ditto,	... Poor workable, } Road to Choulcherrec
	51	Ditto,	... Very poor workable, }
	52	Ditto,	... Ditto ditto.
	53	Ditto,	... Ditto ditto.
	54	Ditto,	... Ditto ditto.

List of Specimens.—(Continued.)

	No.	Locality.	REMARKS.
PALA- EN.	55	Choulcherree,	... A kind of bog ore, poor.
	56	Ditto,	... Heavy rich.
	57	Karee,	... Much on surface, good, workable.
SONA,	58	Karee,	.. Much on surface, heavy workable.
	59	Ketree,	.. Refractory but workable.
	60	Ditto,	.. Workable.
KOH.	61	Kotdwara,	.. Very serviceable iron-stone.
	62	Ditto,	.. Very excellent serviceable ore.
	63	Ditto,	... White fire-clay, good.
	64	Ditto,	... Workable but poor.
ROVA- SON.	65	Lal Dāk,	.. 3 feet bed, poor.
	66	Ditto,	... 2 feet ditto, ditto.
	67	Ditto,	.. Very ditto, ditto.
	68	Ditto,	... Very poor, 2 feet 6 inches.
GANGES,	69	Mundil,	... Poor, small bed, contains lime.
	70	Ditto,	.. Ditto ditto ditto.
	71	Jumnea Bagh,	... A kind of bog ore, rich specimen.
	72	Ditto,	... Heavy and rich, but refractory.
	73	Ditto,	.. Ditto, but not rich.
	74	Tal Nuddee,	... Poor and refractory.
	75	Ditto,	... Ditto ditto.
	76	Ditto,	... Rich, heavy, and refractory, broken from the large mass sent to Roorkee.
	77	Ditto,	.. Rich, but refractory.
	78	Ditto,	... Killas, poor.
	79	Ditto,	.. Carbonaceous slate impure.
	80	Ditto,	... Ditto very impure.
	81	Ditto,	... Lime-stone, tufaceous.
	82	Kotdwara,	... Lignitic coal.
RAM- GUNGA.	83	Dohuleund,	... Good workable ore.
	84	Ditto,	... Workable ore.
	85	Khalagurh,	... Poor.
	86	Lol Jhung,	... Workable iron-stone.
	87	Dehla,	... ditto ditto.

(Signed)

W. SOWERBY,

Civil Engineer.

DECHOUREE, }
The 30th January, 1856. }

No. 301 A. OF 1856.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to the Govt. of the N. W. Provinces,

TO

CECIL BEADON, ESQUIRE,
Secy. to the Government of India,
Home Department,
FORT WILLIAM,

Dated Head-Quarters, Nynsee Tal,
The 3rd May 1856.

PUBLIC WORKS DEPARTMENT.

SIR,

I AM directed by His Honor the Lieutenant-Governor to transmit, for the purpose of being placed before the Right Hon'ble the Governor General in Council, the accompanying copy of a Memorandum, dated 22nd instant, by Lieutenant-Colonel H. Drummond, employed on iron investigations in the Bhabur, explanatory of the failure this year in the effective working of the furnace at Dechouree.

2nd.—The memorandum states the circumstances under which some small excellent specimens of pig iron were produced, two of which, with a specimen also of the imperfectly smelted iron which presents appearances of a highly favorable character, will be transmitted to your office by the Government Bullock Train. It will suffice to show the good working character of the ore.

3rd.—The Lieutenant-Governor would recommend that, if Lieutenant-Colonel Drummond should be permitted to proceed to England, as proposed in my separate letter, No. 295 A of the 30th April, he should be authorized to engage the services for two years of two founders to assist Mr. Davies, who, though very qualified and zealous, is unable, without further European help, to make proper use of the furnace which has been prepared under his direction. It is obviously desirable, whatever resolve he formed in regard to more extensive plans, that a fair and complete trial be made of this experimental furnace, which has failed in the past season only from the want of a sufficient number of qualified workmen. The pig iron produced at this furnace will supply nearly the whole of the yearly demand of the Roorkee work-shops.

4th.—A memorandum with plans, submitted by Mr. Sowerby, and sent with this letter, contains further details of the endeavour to use the

furnace, and of the particulars connected with the Dechouree works, which will be interesting as a guide in further operations.

I have the honor to be,

Sir,

Your most obedient servant,

W. MUIR,

Secy. to Govt. N. W. Provinces.

*Head-Quarters, Nynsee Tal, }
The 3rd May 1856. }*

MEMORANDUM ON THE RECENT IRON SMELTING OPERATIONS EXPERIMENTALLY CONDUCTED AT DECHOUREE.

THE water wheel for supplying the blast having been completed on the 17th March, the heating and charging of the furnace commenced on the 18th, and continued till the 24th, when the blast was put in.

2nd. Shortly afterwards it became apparent that the air-chest was leaking from the shrinking of the timber of which it was composed.

3rd. The leakage increased to such an extent that it was deemed prudent at midnight to stop the operation.

4th. On clearing out the furnace, it was found that the ore had commenced smelting in the most satisfactory manner. Amongst the lumps of metal there was what is called usually "keeshy" iron, (iron highly carburetted) which is always regarded as a sure prognostic of the cast-iron being of the best description.

5th. Mr. Davies, the smelter, was naturally disappointed at the necessity for suspending the operations, but so certain was he of eventual success that he at once placed the metallic lumps which had been removed from the furnace into a small cupola which had been made for brass castings, and without difficulty run them into pigs, a portion of one of which is herewith submitted, and will be found to be cast-iron of the very best quality, and would take the first place in any market.

6th. To obviate the possibility of leakage again occurring, the air-chest (which for its large dimensions was found exceedingly difficult to render perfectly close at all the joinings) was omitted, and the air pipes led at once from the valves of the blast trunks to the tuyeres.

7th. The furnace was again heated and charged on the 10th, 11th and 12th instant, during which time it required constant and unremitting attention.

8th. On the 13th, the blast was put on about the middle of the day and the whole operation progressed most favorably for about twelve hours when the cinder began to descend with such rapidity as to require greater strength and activity to clear the hearth and raise the cinder than one man could accomplish.

9th. Mr. Davies was able by the most violent physical exertions to keep the work going for some hours after this, but the labor entailed upon him, combined with his previous constant watching, tasked his energies beyond their power, and his strength began to fail, when an accident to his eye entirely disabled him.

10th. The work was continued till day-break on the 14th, by Native workmen under Mr. Sowerby's superintendence, but not being possessed of the requisite skill, they were unable to prevent the accumulation of the cinder in the hearth, and consequently the liquid metal could not be drawn from the furnace.

11th. After the blast was taken off and the hearth cleared, a quantity of iron was taken out, of the same description as that which was produced on the former occasion.

12th. To sum up. The work has been stopped only from want of trained hands. It being late in the season, and Mr. Davies having been taken ill, I considered it advisable that the prosecution of the undertaking should be discontinued for the present.

13th. It is satisfactory to add, that Mr. Davies states, that in the course of his 34 years' practical experience, he never saw materials which worked more favorably together and better adapted for the production of cast-iron of the best quality.

14th. The furnace on being cleared out was found to have sustained no damage, the fire-bricks having stood well. As an experiment the success is so far complete that it proves beyond doubt, that at Dechource, the means of producing cast-iron of the best description exist in the greatest profusion.

(Signed) H. DRUMMOND, *Lieut. Colonel,*
On Special Duty.

NYNNE TAL, }
The 22nd April 1856. }

(True Copy,)

W. MUIR,
Secretary to Govt. of the N. W. Provinces.

HIMALAYAN IRON WORKS, KUMAON.
REPORT ON THE EXPERIMENTAL BLAST FURNACE AND OTHER WORKS
AT DECHOUREE.

Introductory Remarks.

1. ON first commencing the works in the beginning of November of last year, considerable difficulty was experienced in obtaining proper workmen, owing to the work being of a new kind in the country, also in obtaining a proper supply of suitable tools, not the smallest previous preparation having been made to supply either workmen or tools, and the great distance of any important station from whence they could be obtained, the nearest being Moradabad or Rampoor about 50 or 60 miles off, caused some delay in the outset. Some tools were supplied by the Commissioner of Kumaon, with as little delay as possible. The workmen who applied for work were all of them of an inferior class and the tools they brought with them were quite unfit for the kind of work to be done. A few better workmen were engaged as the work progressed, but when once men were employed and got a little used to the work, it was inconvenient to change them.

2. In any future works to be done, proper arrangements should be made for engaging good workmen some little time previously, also in the providing of an adequate stock of good tools, when the inconveniences experienced during the progress of the present works would be avoided. The workmen should be engaged for a longer period than from month to month, to prevent their leaving in the middle of the work as some of them did during this season.

THE FURNACE.

3. The foundations having been dug for the furnace, the building of it was commenced about the middle of the month of November. The foundations are built of undressed rubble masonry, the adjacent boulders being split and laid in mud and grouted with the white clay made into a semi-liquid state, and poured into the spaces between the stones; this made a tolerable solid foundation. Lime as mortar would doubtless have been much better, but none having been previously prepared, and the length of time required for burning it, also the want of tools, prevented its being got ready in sufficient time, particularly as the work required to be completed within the working season which had already fairly set in.

4. The whole of the upper walls of the furnace are also built of rough rubble masonry, set in a mixture of lime and mud, the lime being

chiefly brought from Kaleedoongee, where there was a good stock in hand previously prepared. The stones used in the building of the furnace were procured from an adjacent quarry ; the workmen however could not dress them properly.

5. Should any more furnaces be erected in this locality, it would be better to have them built entirely of bricks instead of stone, the stone-masons being such inferior workmen. If a better class of masons can be procured, then stone, which is very plentiful and of a good kind, would probably be the best and cheapest. Furnaces do not of necessity require to be of very fine dressed masonry, the stone only requires to be properly squared.

6. An experiment was made in the manufacture of common bricks from some of the soil in the neighbourhood, about 3,700 having been moulded from some clay found ready puddled, and the result was that the bricks were very good, and the clay most suitable for their manufacture. The clay is found about $1\frac{1}{2}$ mile from where the furnace has been erected.

THE FIRE-BRICKS.

7. On commencing the manufacture of the fire-bricks, considerable difficulty was experienced owing to the material being quite new to the Native workmen and the workmen not being first rate. After about 500 had been made and burnt, the work proceeded in a more satisfactory manner, the workmen having gained confidence in the material.

8. Here again the necessity for urging on the work as rapidly as possible rendered it necessary in order to save time to use the bricks in an unburnt state ; this was an uncertain experiment but the great care taken in the burning of them in their place inside the furnace prevented any bad effects.

9. The quantity of fire bricks made was about 11,000, and have been used as follows :—

Number used in furnace burnt,	...	500
Number do. do. unburnt,	...	4,580
Number do. do. in cupola,	...	200
Number do. do. various,	...	100
Number sent to Roorkee,	...	50
Number in stock,	...	5,150
Number spoiled or waste,	...	420
Total,	...	<u>11,000</u>

10. From the impurities contained in much of the white clay found at Dechouree, it requires to be very carefully selected and prepared in order to make good fire-bricks ; the clay found in many other localities is more free from impurities.

11. As soon as dug it should be first calcined, small charcoal being the best for calcining it ; it should then be ground in a good mill into a fine powder like soorkee, and afterwards mixed with a small portion of the clay and water sufficient to make it plastic. In moulding this would be best done on a good flagged pavement of sufficient area being allowed to remain there till dry ; the bricks if placed on the ground get twisted and spoiled, and frequently crack when drying ; they require also to be turned over and scraped, the loose earth adhering to them, this causes additional labour ; when thoroughly dried they should be burnt in properly constructed kilns with small charcoal. Fire bricks thus carefully prepared would be found equal to the best made in England, which are frequently not prepared with so much care. The proper colour of the bricks is a slight flesh colour, and they are rather tender.

12. The fire-bricks made this season were not made in the above manner for want of time and proper means. They have nevertheless proved sufficiently refractory having stood the heat of the furnace well, the only defect being the cracking of the tunnel head, which should have been hooped with a strong iron hoop.

13. The first fire was lighted in the furnace on the 16th of January of the present year.

THE WATER-WHEEL.

14. The water-wheel that has been constructed for supplying the blast is eighteen feet in diameter and four feet abreast. It has thirty-two buckets, the axle and arms are of saul wood ; the buckets and surrounding is of schymul ; the bearings and beams are also of the latter timber ; the cranks, connecting rods and piston rods are of saul. Saul being a strong wood was found most suitable for the parts it was used for ; schymul is a soft light wood and not durable, but the facility with which it could be obtained of proper sizes, and the ease with which it is worked, was the cause of its being used. Jamin is said to be a more suitable timber for water-works.

15. A wheel of the above size, with a supply of 20 cubic feet of water per second, moving at the rate of ten revolutions per minute, is equal to about thirty-horse power more or less. From the small amount

of work it had to perform, in moving the two blast pistons in the blowing cylinders, not more than 5 or 6 cubic feet of water per second was required, with which it performed twelve to thirteen revolutions per minute, and the same number of strokes in each cylinder. The wheel is therefore capable of working twice as much machinery as it has to work ; it was constructed of this size at the suggestion of the Committee which met at Dechouree in October of last year, under an apprehension that the supply of water would be deficient, and possibly also with a view to the ultimate extension of the works, by the addition of one or more blast furnaces. A wheel of smaller diameter would have been ample for the present experiment.

16. The wheel has been well secured with bolts and screws and paved with a good thickness of tar, also caulked with tarred felt so that it is very substantial. The axle, which is entirely of wood, rests upon brasses, which with the other brasses used were made on the works, being run from a small cupola erected for the purpose.

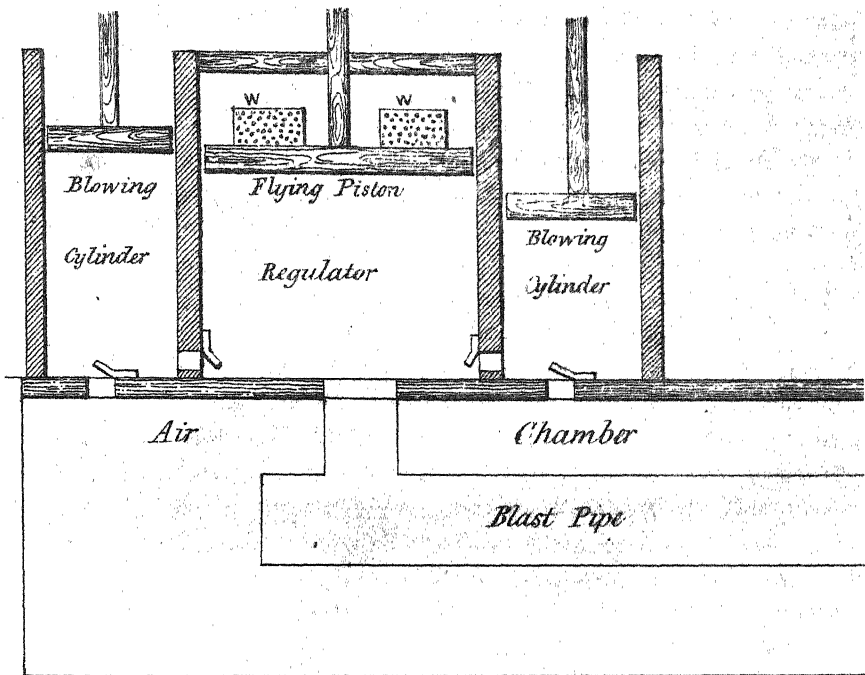
THE BLOWING MACHINERY.

17. The cylinders for supplying the blast are made of deodar timber. They are 3 feet square, and about 7 feet in length. Allowing each piston rod to make a stroke of 6 feet in length, these cylinders with thirteen strokes per minute give a supply of air equal to 1,400 cubic feet ; the quantity requisite for such a furnace as the one erected, is 1,200 cubic feet per minute ; the wood and iron work for these cylinders was prepared at Haul Bagh for a wheel of smaller diameter, otherwise they might have been made 4 to 5 feet square to advantage.

18. The receiver built immediately under the blast cylinders, was built up of stone and lined with wood, well caulked and tarred. It was about ten times the cubical contents of one of the cylinders. This was intended to act as a regulator to the blast, but from the shrinking of the wood, and other causes, it was found on the blast being put on not to be perfectly air-tight, and a very imperfect regulator, the blast being intermittent. When the whole of the machinery is of iron and nicely adjusted, and the air-cylinders are worked by steam-power or well constructed water-wheels, an air-chamber is found to be a sufficient regulator, but any slight deviation from the truth in the adjustment of the machinery owing to its being of wood, causes the blast to be irregular, notwithstanding the air-chamber ; sometimes the intermittent blast is

allowed to be good but generally it is not so. Practical men are slightly at variance on the subject, the regular blast is however preferable.

19. The Air-chamber or Receiver was made at the suggestion of some one of the Committee who met at Dechouree in October last, and not having proved effectual for this particular kind of apparatus. The better plan would have been the introduction of the old fashioned flying piston, as shown in the Sketch below, thus :—



The air being injected from the cylinders into the regulator, the flying piston is forced up and gradually descends, being weighted as shown in sketch. By having cast-iron tops to the blowing cylinders, and wrought-iron piston rods, they could be made double action, working up and down, thereby increasing the effective force of the blast and obviating the necessity for a regulator or air-chamber; this would be somewhat more complex than the plan adopted. The air-chamber having been found defective, the blowing cylinders were subsequently connected with the main blast pipe, by the simple addition of short branch pipes.

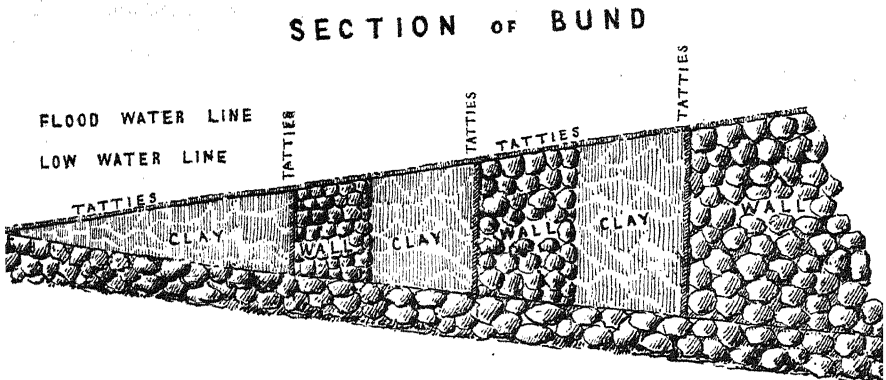
20. The blast pipes are also of saul wood, being made out of large-sized hollow trees, split and properly dressed inside, then put together again with tarred felt at the joints and firmly secured by means of strong iron bolts.

THE BUND AND WATER-COURSE.

21. The construction of reservoirs was suggested by the Committee who met in October last, for the purpose of keeping up the supply of water during the hot weather.

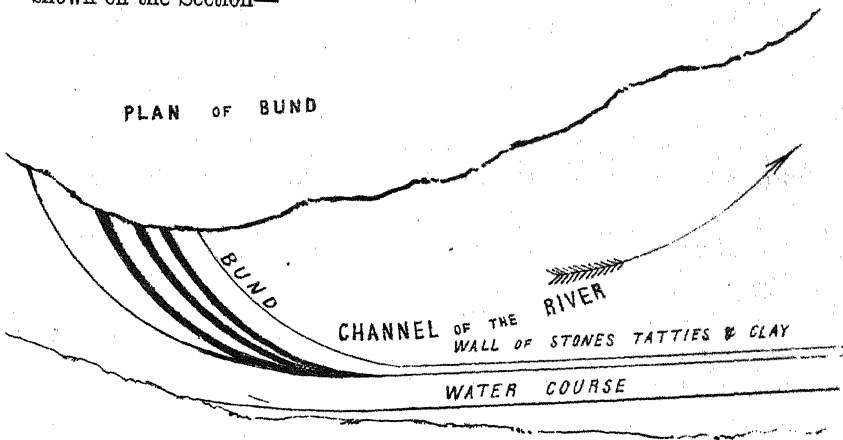
After the most careful enquiries as to the quantity of water likely to remain in the river during the hot months, it was ascertained that it would be quite ample for the present experiment; it was therefore considered unadvisable to construct any reservoirs this season, particularly as they would have been very expensive works, and of very large dimensions to render them of any practical utility.

22. A bund was therefore constructed across the river at the head of the gools or water-courses, in order to bring the whole of the water in the river along the upper channel. This bund was constructed with rough boulders and other stones found in and adjacent to the river, according to the following Section, thus :—



23. A series of dry rubble walls have been built in an oblique direction across the river, with a slight curve upwards, according to the following Plan, and as shown in the Section above. At the upper sides of these walls tatties made of grass and bamboos were fixed and the spaces between the walls were then filled in with clay and mud and soil—the whole was then covered with other tatties, and a covering of soil and

stones with clay was laid over all, trimming it off to a gentle slope, as shown on the Section—



24. This bund has proved quite effectual in bringing the whole of the water coming down the river into the upper channel which latter has been repaired by contract.

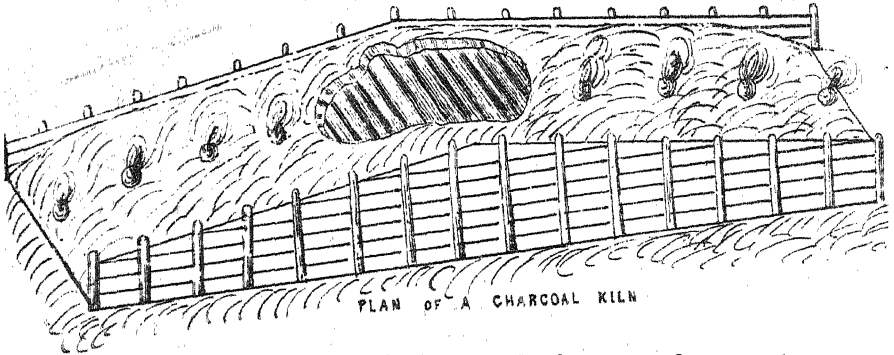
25. The chief difficulty in the construction of bunds or weirs in impetuous mountain streams like the River Boer is that of getting down to the solid rock for a foundation, the bed of the river being generally composed of loose gravel and boulders to a considerable depth, but seldom to so great a depth in this river as to present any very serious obstacles. In making such bunds, it is desirable to select some point in the river where the water flows with the least violence, and where it is not very narrow. The bund should be formed in an oblique direction to the river's course, so that the water would be spread over a long line of over-fall, and would in consequence flow gently over it. If the bund is placed at right angles with the banks of the river, it would be certain to be washed down very soon, and the higher the bund is constructed, the less liable it would be to be washed down, owing to there being a longer space of comparatively still-water above the weir, and the shock of the current being thereby removed to a distance from the over-fall.

THE CHARCOAL.

26. Preparations for making charcoal were commenced at an early period of the season in order to spread the making of it over as long a time as possible, the making of a large quantity quickly, requiring exten-

sive preparations in the shape of planking, &c., for the sides of the kilns. One small kiln and two large ones were constructed and kept going for several weeks and latterly four large and three small kilns were in operation, but for a short time only.

27. The plan adopted is shown in the following Sketch, thus:—



Uprights are placed firmly in the ground 4 feet apart, the row of uprights for each side being about 9 feet distant. Inside of these upright planks are secured either by wooden pegs, or by having the uprights double and slipping the planks in between them; the latter plan was found to be the best, owing to the facility with which the planks could be taken out and put in, for drawing and charging the kilns. The first kilns constructed were made to slope in one direction only, the upper end being planked like the sides, and the kiln was lighted at one end only. During the progress of the works an improvement was introduced by taking away the back planks and making them slope in both directions from the middle; by this plan the wood was better and more quickly charred, being lighted at both ends and drawn in the same manner.

28. The wood for charring requires to be cut into lengths of 4 feet and piled crossways in the kiln, being well packed; when piled to the proper height the space between the wood and the planks is to be filled with earth and well rammed in, the top being covered with leaves and a layer of soil about 3 or 4 inches thick on the top of the leaves, leaving spaces on the top uncovered until the kiln is fairly lighted. Kilns constructed on this plan with dry wood may be opened and the charcoal drawn at each end within twenty-four hours after being lighted; the better plan however is to allow them to remain eight or nine days as the yield is better and they are more easily drawn.

The height and length of a kiln is quite optional ; kilns of 80 feet in length and 7 feet high in the middle and 3 feet at each end, were constructed, an uniform width of 9 feet was found to be the best.

29. The kind of wood chiefly used was saul, because it was found in such great abundance lying on the ground ready dried, and of no use whatever for any other purpose, having been left there to rot, being rejected by the timber cutters, though they were by no means small trees. The quantity of wood thus available must be immense, as after continuing to use it at one spot for a period of nearly three months there was no apparent diminution in quantity, layer after layer being taken and cut up of quite sound timber, evidently the accumulated cuttings of very many years. Saul wood makes an excellent charcoal, and yields well, as also khyr, huldo, sissoo, jamin, jingnu, sindoo and aorla; the khyr is excellent but small, it is said to be of rapid growth; the huldo is very plentiful, the trees being very large; the soft light woods make but an inferior charcoal. Wood of all sizes were used up to 2 feet 6 inches in diameter, which when placed in the heart of the kilns got well charred throughout.

30. The quantity manufactured, was about 1,500 maunds or fifty tons, at a total cost of 808 Rupees, including every expense both for building kilns, planks and carrying to the works, thus :—

							Rs.	As.	P.
31.	Cutting planks, &c.,	-	-	-	-	-	95	12	0
	Building kilns,	-	-	-	-	-	138	4	1
	Making charcoal,	-	-	-	-	-	474	12	6
	Leading to Works, -	-	-	-	-	-	99	14	0

Total Rupees 808 10 7

32. The actual cost of making the charcoal was therefore about 9 Rupees 8 annas per ton or a little more than 5 annas per maund, and nearly 2 Rupees per ton, for leading the cutting of planks and building kilns being looked upon as plant.

33. At the commencement it was attempted to get the charcoal made and delivered by contract, but though 10 annas per maund was offered for good sized charcoal none but of a most inferior kind and far too small for the furnace was ever delivered. Towards the latter end of the season however a contract for making and delivering the charcoal was

given out at 3 annas per maund and about one-hundred maunds were delivered of tolerably good charcoal; task work was also given out for cutting the wood in lengths of 4 feet at the rate of 10 Rupees per thousand pieces.

34. The labourers employed at first required some little teaching, but towards the latter end of the work they became much more skilful and the work went on in a most satisfactory manner; some difficulty had been apprehended on this head at the outset, and even the bringing out of an European charcoal-burner was thought of. The work however has been found so very simple that an Eurasian boy, sixteen years of age, was capable of conducting the whole operation.

35. The necessity of doing the whole of the work by day labourers caused it to be much more expensive than it otherwise would have been, and the tools used in cutting the wood were of so inferior a kind as to very materially increase the labour and cost of preparing it for the kilns. Towards the latter end of the season a set of new axes were procured from the Roorkee Works, but though of large size and apparently strong implements, they were made of such inferior material, that the first blow generally broke their edges and rendered them unfit for use until repaired, and they required to be constantly repaired afterwards.

36. The quantity of charcoal taken from a kiln 80 feet long 9 feet wide and 7 feet high in the middle, was about 125 maunds. Six of such kilns would therefore be required to keep one blast furnace at work, producing twenty tons of iron per week. This would require the daily labour of 300 coolies for six days in the week, supposing the charcoal to cost 5 annas per maund, and at 3 annas per maund 190 labourers.

37. The making of charcoal will at all times require the greatest attention particularly in the general arrangements, doing as much by task work as possible, where a man and his family can all be employed, as on this the future success of any works will greatly depend. It would be advisable to prepare a good stock during the cold and dry season of the year, as it cannot be properly made during the rains.

38. No very important improvements can be made upon the plan adopted, as it is one of those things, which is in itself so simple and complete that all attempts at improvement would only lead to expense without obtaining any adequate or beneficial result. The details of working the kilns and getting the wood are capable of some improvements, which will readily suggest themselves to any person having charge of the work.

39. After the heavy periodic rains, there is always a large quantity of underwood springs up. This together with the thin branches of trees cut down might be charred in ovens and then compressed into blocks, like pent charcoal at Home in England, Ireland, &c., thus becoming a kind of patent fuel; this together with the small waste charcoal from the kilns, if mixed with tar might also probably form an excellent fuel for the puddling furnaces.

THE TRAM-WAY.

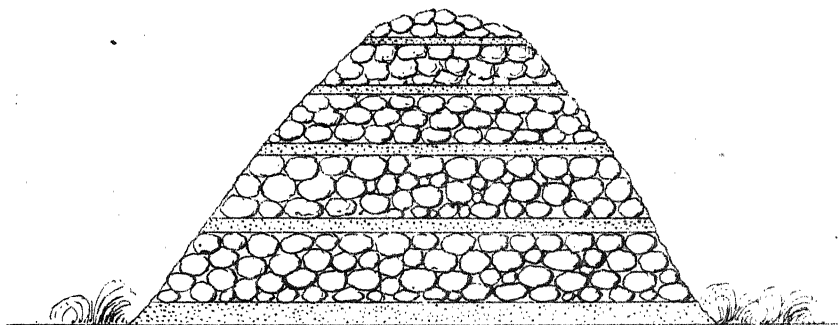
40. The expense and delay, in bringing the charcoal from the forest by bullock-hackeries, would render it absolutely necessary to introduce, at an early period, the laying down of cheap tram-ways.

41. A short piece of wooden tram-way was laid down (and timber cut for a longer) in order to ascertain the cost of such work, and from the data obtained, it has been estimated that the expense would be from 300 Rupees to 500 Rupees per mile according to nature of the ground.

The early manufacture of cast-iron tram-plates would render wooden trams unnecessary, as iron trams are so quickly and easily taken up and laid down so as to suit the work, and are not damaged by being removed as wooden ones are.

CALCINING ORE.

42. Only a small portion of the iron stone was calcined for the recent experiment. The ore when calcined presented the appearance of iron-stone of the best quality; the red ore and yellow hydrated were both calcined and turned out good. A portion was calcined with wood but the best plan is by means of small waste charcoal from the kilns not suitable for the furnace, and always obtainable in plenty. The plan adopted was in heaps, thus:—



43. A layer of charcoal about 3 inches thick being placed at the bottom and then about 2 feet of ore broken into pieces, the size of the fist—afterwards successive layers of charcoal and iron stone, an inch thick of charcoal being sufficient to 1 foot thick of ore. The cost of calcining the ore was about 1 anna per maund or 1 Rupee 12 annas per ton. This may ultimately all be done as task work, by a man and his family being employed.

LIME-STONE.

44. The lime-stone is very plentiful on the spot; the cost of preparing it would be merely that of breaking it up into a proper size, which would with good tools, amount to about $\frac{3}{4}$ ths of an anna per maund.

45. The bringing of the lime-stone as well as the iron-stone to the works was by means of coolies; a short tram-way will ultimately be found to be best and cheapest.

TRIALS OF THE BLAST FURNACE.

Trial No. 1.

46. On the 17th of March the wheel being complete, the water was put on and worked well, there being no defect in this part of the machinery nor any short coming of water, the water being much in excess of what was actually required; the blowing apparatus was still not quite completed, but was finished on the 22nd of the month.

47. The furnace having been heated up to the proper heat by wood and charcoal, the charges of ore were put in on the 23rd and on the following day the blast was put upon the furnace for the first time.

48. For some time the whole of the machinery worked well, but the pressure of the blast was not more than $\frac{1}{4}$ lb. on the inch, as near as could be estimated without a proper gauge; this was low but sufficient, there being evidently an escape of air in the air-chamber and wooden pipes; gradually as the blast continued the leakage became greater, and the power weaker until it was as low as $\frac{1}{4}$ lb. on the inch; this was an insufficient blast for the proper working of the furnace as it was charged, and it was therefore considered advisable to take off the blast and withdraw the charges in the furnace in preference to allowing it to go on and thereby run the risk of choking up the hearth with imperfectly smelted iron the taking out of which would have damaged the furnace materially.

49. During the greater part of the time the blast was on, the whole of the materials appeared to work well together and when the fire was reduced

a quantity of properly smelted iron was taken out from the bottom of the furnace or hearth, but too small in quantity and not sufficiently collected together to have found its way out at the tap-hole had the furnace been tapped.

50. During the time the furnace was being cleared out, steps were taken to remedy the defective blast apparatus, by doing away with the air chamber, where the air leaked most, owing to the shrinking of the wooden lining, and connecting the cylinders with the blast pipes by the addition of another large pipe and branch pipes; this having been completed and the pipes well tarred and recaulked with hemp prevented the escape of air.

51. The iron taken out of the furnace was found to be of good quality. Pieces of what is known amongst workmen by the name of keesh, that is highly carburetted iron, were taken out, a certain indication that the yield of iron will be of very good quality; the lumps were collected together and readily remelted in the small cupola, with a little fan-blowing apparatus, which had been erected for making the brasses required on the works; the iron was very easily remelted and flowed out in a very liquid state into several small pigs, which when fractured showed them to be iron of the very best quality, known in the trade as "No. 1 Grey metal pigs first quality."

TRIAL No. 2.

52. As soon as the blowing apparatus was again put into order, the furnace was reheated and charged, and on the 13th of the present month (April) the blast was again put on, and was this time found to be upwards of 11b pressure as nearly as could be estimated, but more intermittent than before. During the first twelve hours the whole of the materials worked well together as heretofore, and the machinery performed its part properly. About this time the cinder began to come down quickly and not in a very liquid state, probably owing to some small disproportion of lime used as the flut, and it required active exertions to keep the fore hearth clear. This was done for some few hours, and the cinder flowed over the dam but not very freely. The proportioning of the lime and other furnace materials can only be ascertained by actual practice with the furnace, and the proportions require changing frequently just as the furnace works, according to the judgment of the keeper. The altering of the proportions

from time to time does not necessarily involve the stopping of the furnace every time but simply altering the charges above, keeping the hearth and twyers clean by raising the cinder with heavy crowbars.

53. This requires an amount of manual dexterity and practical acquaintance with the subject, which can only be acquired by a long apprenticeship to the business of a furnace-keeper; there being but one such man on the works, he continued to exert himself until quite exhausted, with the aid of Native labourers, by whom the work was kept going for several hours, but from the amount of physical exertion required and the heavy nature of the implements, together with the fierce character of the work to which they were quite unaccustomed, and being altogether untrained, they were unable to keep the furnace in proper order. After it had been kept going for about twenty hours, the furnace was tried to be lapped, but the metal was too far back and too small in quantity to find its way to the tap-hole. The first tapping is generally at the end of twenty-four hours, more or less, according to circumstances, during which time the work of keeping it in order is generally by far the most difficult; by and bye when the furnace is fairly in operation and the proportions of lime, iron-stone and fuel have been well ascertained, the liquid cinder flowing freely over the dam, then the keeping of it in order is easier; if the furnace could by any means have been kept properly at work and in order up to the end of the twenty-four hours after the blast was put on, and the first cast had been taken, it might then have been continued a little longer, possibly one or two days, but this would have been the utmost limit that could have been done this season, without the aid of a few additional properly qualified smelters. The qualifications of the Natives as smelters have not yet been properly tested, but from what has been seen of them, and from their previous knowledge and their observations and remarks during the progress of the experiments, it is believed that they will ultimately become very fair workmen, but in any future works undertaken it would be exceedingly injudicious to depend on them for working at first; it would be better and more prudent to incur the expense of bringing out a sufficient number of European smelters accustomed to the work, who if well selected and good useful men in other departments as well, could, when the Natives were trained to take part in the work, be the means of extending the number of furnaces and other works; any short coming

in respect of European workmen at the outset would in the end prove to be a false economy.

54. The iron taken out after the second trial was the same as the first, the furnace having sustained no damage.

CONCLUDING OBSERVATIONS.

55. In the General Summary of the Preliminary Survey of the Bhabur Iron Fields, from the Golah to the Ganges, it was estimated that the number of blast furnaces that could be kept in operation by the forest fuel was two hundred. This is however by no means the maximum that might be kept in operation by a proper management of the forests, but the introduction of an important manufacture like that of iron would of itself create an increased demand for timber which would require to be supplied from the forests. The number therefore that might be judiciously erected is sixty, and placed at the following localities—

56. Ganges, - - -	-	6 Furnaces.
Ditto, - - -	-	Rolling Mills.
Lal Daug, - - -	-	2 Furnaces.
Kotdwara, - - -	-	4 Furnaces.
Lona River, - - -	-	4 Furnaces.
Choulcherree, - - -	-	2 Furnaces.
Ramgunga, near Boxsur, &c., -	-	6 Furnaces.
Kalagurb, - - -	-	6 Furnaces.
Ramgunga, - - -	-	Rolling Mills.
Ramnugger and along the Kossilla,	-	12 Furnaces.
Kossilla River, - - -	-	Rolling Mills.
The Kitcheree, - - -	-	4 Furnaces.
The Dubka, - - -	-	2 Furnaces.
The Boer Dechouree, - - -	-	4 Furnaces.
Dechouree, - - -	-	Rolling Mills.
Loha Bhur Bhur, - - -	-	2 Furnaces.
The Golah Huldwanee, - - -	-	6 Furnaces.
Huldwanee, - - -	-	Rolling Mills.
Total, - - -		60 Furnaces.
		5 Rolling Mills.

57. The capabilities of the country east of the golah have not yet been clearly ascertained ; fuel and iron-stone are known to be abundant.

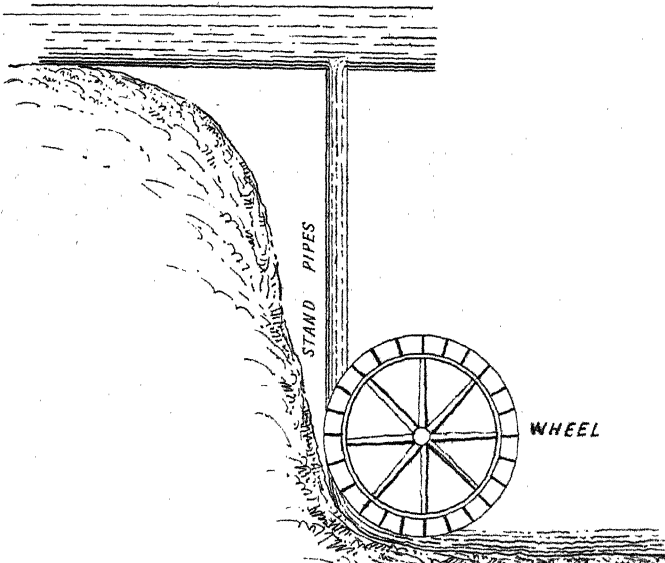
58. During a part of the year the climate of the Bhabur has the reputation of being unhealthy ; whether it is more so than any other country would be with dense forests, the result of heavy periodic rains and a hot climate is doubtful ; even temperate climates are known to have been and are still unhealthy in some parts of the world under similar circumstances ; on the establishing of works however some caution would be necessary in this respect.

59. Dechouree, from its comparatively elevated position and consequent healthiness, appears to be one of the best localities for commencing works ; the chief defect urged against this place is the limited quantity of water in the River Boer during a month or two in the hot season.

60. In a former Report, dated November 14th, 1855, the question of water supply at Dechouree was discussed, and the possibility of having to use auxiliary steam-power was referred to. After the most careful enquiry on the ground from land cultivators, and from actual observation of the stream, it is believed that the stream at the head of the present gools or water-courses is never less than twenty feet per second in the driest time of the year, and a little further up the river it is even as much as twenty-five to thirty cubic feet per second. The river is chiefly supplied from springs, and the body of water in the river varies at different parts according to the retentive character of its bed or otherwise. With such a supply of water very large works might be established by proper arrangements.

61. The construction of reservoirs has been suggested to make up for any deficiency of supply of water. Several places exist where such reservoirs might be constructed of large dimensions, where, if the ground was not sufficiently retentive, it might be puddled with clay. The construction of such reservoirs would require to form part of a well devised and carefully considered plan to be of any use. They would add but slightly to any continued power that might be required, such as for blast furnaces, but by being allowed to accumulate by night, the water would be available for driving rolling mills, lift and tilt hammers, and such other machinery as need only be worked by day.

62. A great deal may also be done with a small quantity of water, by bringing it down upon wheels by means of high stand pipes—thus :



With wheels constructed on this principle a very great amount of power is obtainable when there is only a small supply of water, and the high velocity which they acquire renders them peculiarly well adapted for driving rolling mills. This kind of wheel differs from the turbine, and suggested itself to me during the progress of the works.

63. A small experimental wheel on this principle was erected for driving the fan blast to the smith's forge and little cupola erected for melting brass. It performed seventeen revolutions per minute, with a small supply of water, and though rudely and roughly put together fully exemplified the principle. Steam-engines have been made upon a similar principle in England for several years and have been highly approved. The above plan for a water-wheel has, I have been informed, been recently patented in England.

64. Assuming however that the water is as low as ten cubic feet per second, still a very great deal may be done with it, and that the river is quite dry every seven years as stated by Mr. Ex-Commissioner Batten, even then it would not be necessary to adopt steam as a motive power until steam-engines can be made on the spot; the stoppage of steam-engines for repairs and renewal of boilers would be quite equal to the

stoppages from any deficiency in the supply of water. The longer steam power can be dispensed with the better, simply because of the fuel. Coal can only be useful as fuel; wood is useful for very many other purposes. It is true that the waste heat of the furnaces can be made use of, but this involves complicated arrangement of the works.

65. The objections with regard to water power would not arise if the works were commenced on the banks of the Kosilla or Gola, where the quantity of water is unquestionable, and the furnace materials are quite abundant. These localities are said to be less healthy than Dechouree. The superiority of the latter place cannot however be so very great, and it would undoubtedly be more prudent and advisable to run the risk of having to suspend the works for one or two months in the year than to incur the expense, risk and delay of importing and erecting expensive steam machinery.

66. Under any circumstances it would be most desirable to have branch works a little way into the interior of the hills, the Agar District near Ramgurh, being the nearest to the plains, and well supplied with iron-ore, wood and water power, would be the best. Such branch works would always be available, in the event of the works in the Bhabur having to be suspended for a short time, from any apprehension of unhealthiness or short-coming of water; they would also be valuable for removing the European workmen, who could reside there during short periods occasionally for change of air, being thus usefully employed instead of remaining entirely idle.

67. In the establishment of new works of this kind, their success will depend rather upon the excellence and completeness of the arrangement made amongst the Native labourers, (on whom will fall the great bulk of the work) and in the selection of European workmen than upon any short-coming of suitable materials or want of facilities. Very few countries possess so many local advantages of every kind and in such superabundance, to reject any one of which would show a want of judgment. There are doubtless some risks to be run in the commencement, and some errors will be committed, any thing like a failure however of the works as a commercial speculation will most certainly be the result of mismanagement or misapplication of capital, from an erroneous conception of the proper mode of carrying out the works.

68. The building of the furnaces and other works will be found to be the least difficult part of the whole enterprize. When one or two fur-

naces are fairly in operation, it will then entirely depend upon the energy displayed in extending the works, and the amount of capital forthcoming to carry them out, to the extent that the requirements of the country demand.

WM. SOWERBY, *Asso. Inst., C. E.*
Engineer in charge of the Works.

NYNEE TAL, }
April 25th, 1856. }

ABSTRACT OF EXPENDITURE ON ACCOUNT OF THE WORKS AT DECHOUREE.

	Rs.	As.	P.
Building of furnace and water-wheel, -	5,854	6	2
Making fire-bricks, - - - - -	419	13	3
Making red bricks, - - - - -	22	12	11
Calcining ore, - - - - -	12	13	10
Lime, - - - - -	732	3	8
Materials, brass, tar, hemp, &c., - - -	808	4	9
Building workmens' house and tool house, -	198	7	3
Charcoal making, - - - - -	808	10	7
Making roads, - - - - -	202	7	11
Tram-way, - - - - -	330	5	0
Making bund and repairing water-course, -	254	11	4
Sundries, - - - - -	833	14	0
Total Rupees, -	10,478	14	8

NOTE. The whole of the works have cost at least 25 per cent. more than they should have done for want of good tools, good workmen and previous preparations.

W. SOWERBY,
Engineer in charge of the Works.

A plan of the furnace and machinery accompanies this Report.

Also—

A specimen of keesh.

A pig of iron cast after the first experiment.

A lump of iron out of the furnace after the second experiment.

No. 699.

To

C. B. THORNHILL, Esq.,
Offg. Secy. to the Govt., N. W. P.

HOME DEPARTMENT.

SIR,

I AM directed to acknowledge the receipt of Mr. Secretary Muir's letter, No. 301 A. of the 3rd ultimo, with enclosures, relative to the Government Iron Works at Kumaon, and in reply to state, for the information of the Hon'ble the Lieutenant-Governor, that the Hon'ble the Court of Directors will be requested to engage the services of two founders for the works.

I have, &c.,

(Signed) R. B. CHAPMAN,

Offg. Under-Secy. to the Govt. of India.

Fort William, 6th June 1856.
